THE
AMERICAN ANTHROPOLOGIST.

VOL. I. WASHINGTON, D. C., JANUARY, 1888. No. 1.

THE LAW OF MALTHUS.

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There were Malthusians in the world before Malthus. Plato proposed to regulate the conditions of marriage in his ideal republic with a view to the equality of the sexes, the limitation of population in point of its quality, and the community of property. Aristotle charged Plato with inconsistency in not providing for limitations on the number as well as the quality of the offspring born within the confines of the State, and justly argued that without such restrictions in point of number it would be impossible to maintain an equal distribution of property. The constant pressure of population on the means of subsistence and on the average rates of private maintenance had thus been observed of old time, and measures were devised in real as well as ideal republics for the purpose of meeting it; though in real republics the measures taken under this head, as in most other cases involving a consensus of political opinions, did not proceed from a full consciousness of all the elements involved in the particular problem set for solution. So that while this pressure has been perpetually exerting its power at every stage of human history, and while men have constantly acted under its influence in their concrete masses, it does not follow that the nature, working, and effect of that pressure were clearly perceived or understood in point of law or principle.

Montesquieu caught a passing glimpse of the principle of population in his *Esprit des Lois*,* and the elder Mirabeau, in his *"Ami des Hommes ou Traité de la Population,"* † clearly enounced the

* Livre xxiii, Ch. 10.

† Tome viii, p. 84.

doctrine that "the measure of subsistence is the measure of population." Adam Smith, in his "Wealth of Nations," adverted to the relation between food supply and the natural multiplication of the human species, and saw no way in which "the inferior ranks of the people" could escape the pressure of the latter unless the scantiness of food should "destroy a great part of the children which their fruitful marriages produce."*

The Abbe Ortes, in his "*Riflessioni sulla Popolazione*," published at Venice in 1790, entered into a calculation as to the natural increase of population from a single pair on the supposition that four children, two of each sex, survive from each marriage union to become in their turn the founders of families. He shows that while the successive dates of their marriages would move in an arithmetical order the increase of their progeny would multiply in a geometrical order, and that hence the number of their children, at the end of nine hundred years, would be, if otherwise unrestricted, 7,516,192,768 souls, while if men had been left to multiply at the same rate for six thousand years the surface of the whole globe, "from its lowest valleys to its steepest mountains, would not be able to hold them, even should they be crowded and packed like dead and dried herrings in a barrel."† He then proceeds to argue that human reason conspires with the order of nature to put a limit on the growth of population beyond a certain fixed number determined by the capacity of the earth to nurture them.

Whatever men may think of Malthus or his doctrines, it must be conceded, as Bonar phrases it, that, though others before him reasoned up to the principle of the law of population, he was the first economist who undertook to reason down from it as offering a solution for a number of dependent questions "in the way of simple corollaries."‡ He saw that if by his method of reasoning he had reached a scientific induction that induction could authenticate and maintain itself only by affording a basis for logical deductions which should be capable of verification in history, and which should lend themselves to that ability of prediction which is the crucial test of scientific prevision. He frankly accepted the test, and hence the detailed and operose exposition of his thesis in the light of universal history—a method of treatment in which he pursued his doc-

* Vol. I, Ch. 8. † *Riflessioni*, &c., Ch. 2.

‡ James Bonar, "Malthus and his Work," p. 19.

trine only too absolutely to its logical consequences, though well aware that in doing so he might, by incidental errors of fact and inference, "open the door to many objections and expose himself to much severity of criticism."*

The fundamental doctrine of Malthus, disengaged from the historical, theoretical, and mathematical apparatus with which he encumbered rather than strengthened it, is this: That population has a tendency to multiply itself beyond the conditions of subsistence. He is commonly supposed to have held that this tendency is not only inherent, but that it is *always* revealing itself in terms of effect as well as in terms of causative force; but this is a mistake. At the very threshold of his discussion he admits that in the actual course of history there has been a constant oscillation of the pendulum between population and food—an oscillation irregular and obscure in the mode and periodicity of its librations, but none the less obvious to the discerning student of history.†

It has been common, too, to suppose that Malthus has complicated the truth of his theory with certain geometrical and arithmetical ratios assumed to represent, respectively, the multiplying capacity of population and food. But, as Horatio says in the play, "'Twere to consider too curiously to consider so." Malthus has not bound up the truth of his theory with the reality and uniformity of these particular ratios. The particular ratio placed at the forefront of his discussion, to mark a tendency which must be accepted as potential in the case of population (because in one instance at least it can be shown to have been actual), was drawn from the law of the growth of population in these United States, where the population at the date of Malthus's writing was found to double itself every twenty-four years. Assuming that the population of the whole earth should increase at this rate, while the increase of subsistence "could not possibly [he thought] be made to increase faster than in an arithmetical ratio," he does state, with this modulus of his geometrical progression and with this hypothesis of the food ratio, that the human race *would* increase as 1, 2, 4, 8, 16, 32, 64, 128, 256 in the course of two hundred years; and in case food should increase during the same period only as 1, 2, 3, 4, 5, 6, 7, 8, 9, it would follow that at the end of these two hundred years population

* Malthus: Principle of Population, vol. iii, p. 325, edition of 1817.

† Ibidem, vol. i, p. 27.

would be to the means of subsistence as 256 to 9, in three centuries as 4,096 to 13, and in two thousand years the difference would be incalculable. This mathematical comparison is used by Malthus as a descriptive illustration rather than as the formula of a scientific truth, as the index of a potential tendency which may be assumed as speculatively possible rather than as the register of any fixed and invariable law of population.

In point of fact this mathematical *rapprochement* of the two ratios is very unhappy, even for purposes of rhetorical illustration or of numerical comparison, for there is no proper commensurability between the two series in point of their motive forces. As Bonar justly says, "population is increased by itself, while food is increased, not by food itself, but by an agency external to it, the human beings that want it." Malthus saw this distinction as clearly as anybody else, and, when pressed in argument on this score by the well-known British economist, Nassau William Senior,* he was frank to admit the incongruity of the comparison, without, however, formally retracting it. Writing in the year 1829, more than thirty years after the first appearance of his essay, he said:

"In old States the relative increase of population and food has been found to be practically very variable. It is no doubt true that in every stage of society there have been some nations where, from ignorance and want of foresight, the laboring classes have lived very miserably, and both the food and the population have been nearly stationary long before the resources of the soil had approached toward exhaustion. Of these nations it might safely have been predicted that, in the progress of civilization and improvement, a period would occur *when food would increase faster than population.*"

In the appendices attached to the later editions of his essay, Malthus tacitly withdrew the earlier overstatements of his case and admitted that in the rigorous form too often given to the enunciation of his principle "it was possible that, having found the bow bent too much one way, he was induced to bend it too much the other in order to make it straight." †

As Columbus stumbled on the discovery of a new world in seeking to find a western path to the Indies, so Malthus stumbled on the

* Nassau Wm. Senior, "Two Lectures on Population," with letters of Malthus in the Appendix, p. 67.

† Malthus, "Principle of Population," vol. iii, p. 427, ed. of 1817.

discovery of what he calls "the principle of population" in trying to write down the sociological doctrines of William Godwin, the Henry George of England in 1793. He commenced by being a political pamphleteer. He ended by being a political economist and a social philosopher. But in bending his bow on the skirmish line of a now forgotten controversy he often overshot his mark and wasted from his full quiver many an arrow which, like that of Acestes in the epic verse of Virgil, marked its way, indeed, with a blazing light, but soon vanished into thin air because it had been aimed at nothing more substantial than the dissolving clouds of a transient gust in the political atmosphere. Among all the things that have been said in just praise of Malthus and in just abatement of the abuse that has been lavished upon him, there is nothing finer or juster than the remark of his latest critic and apologist when he says: "Science seeking answers to its own questions and not to the questions of the eighteenth century has no toleration for the false emphasis of passing controversy."* The student who has not patience enough to follow Malthus in all the variations, modifications, retractions, and omissions to which he subjected his "principle" in the six successive editions of his essay from 1798 to 1826 had better renounce all hope of being a Malthusian disciple at first hand, and should content himself with such ready-made opinions as can be got at second hand from thick-and-thin admirers or thick-and-thin haters of the Haileybury professor. He was a bright and shining light in the sky of British economic speculation from 1798 to 1826, but if we would fix his true position or define his true orbit we must make allowance for his historical parallax as seen from these two dates, separated by an interval of nearly thirty years, during which his oscillations of thought betrayed the manifold perturbations to which the body of his doctrine was exposed from the tug and strain of a secular polemic. Science in the making is *eristic*, bringing strife; science made and perfected is *irenic*, bringing peace.

Before Malthus's day the proverbial wisdom of the world found cheap and easy expression in the happy-go-lucky adage: "Wherever Providence sends mouths He sends meat enough to feed them." Malthus turned the adage upside down, or downside up if you please, and made it read as follows: "Wherever Providence sends meat He sends mouths more than enough to eat it." If population

* Bonar, "Malthus and His Work," p. 24.

has a tendency to increase beyond the means of subsistence and is kept down to the level of the latter by the checks which repress the superior power of the former, and if these checks are all resolvable into "moral restraint," preventing superfluous births, and "vice and misery," extinguishing superfluous lives, then it follows that the life of man here below is not only a constant "struggle for existence," but a struggle for existence under difficulties which can never be surmounted. In the emphasis given by Malthus to the "struggle for existence" (for this phrase is Malthus's before it was Darwin's) we might almost be tempted to say that Darwinism is little more than Malthusianism "writ large."* But, happily for the theory of Darwin, it finds a door of hope for the origin and improvement of species where Malthus found the very valley of Achor for that part of the animal world which, in being charged with dominion over plants and inferior animals, might have been least expected to exemplify the struggle. In man, where the struggle for existence is really reduced to its minimum, Malthus saw it at its maximum. Whereas Darwin saw this struggle replete with beneficent promise for the improvement of species in plants and lower animals, Malthus, at least in his first desponding outlook on human history, was tempted to see in man's struggle for existence little more than a losing battle, which was ever beginning and never ending, because fought under the shadow of a remorseless destiny which doomed each sally to break to pieces against the same impassable barrier—a paucity of food.

Yet it would be a great mistake to suppose that Malthus was a "malignant philanthropist"—he was a true lover of his race; or that he was a reactionary politician—in politics he was a liberal Whig. It has, indeed, been charged that he favored the slave-trade as an economic expedient justified by the necessities of population in Europe. In fact he was inflexibly opposed to that odious traffic. It has been charged that he was an ascetic and surly misogamist. In fact he was a good family man and begat sons and daughters, though the myth of his eleven daughters is apochryphal. It has been charged that he looked with complacency on wars, pestilences, and famines as subserving a good purpose by thinning out an overcrowded population. In fact he aimed by his whole philosophy to

*Cf. Darwin, Origin of Species, p. 50: "It is the doctrine of Malthus applied with manifold force to the whole animal and vegetable kingdoms."

teach a prophylaxis against these plagues of humanity. Refuse polemics of this sort may well be relegated at once to the kitchen-middens of an obsolete period. It is somewhat trying to find a master of rhetoric like Henry George not unwilling, even at this late day, to garble a whole passage in the first essay of Malthus that he may fling his dynamite bomb full in the face of the English professor, and this, too, a passage which Malthus withdrew and expunged in every edition of his work published after the year 1803. Though Malthus has apologized for the entire form and contents of the first edition as having been "written on the impulse of the occasion and from the few materials which were then in his reach," the unreasoning opponents of his theory continue to burrow in this edition for stones of stumbling and rocks of offence. It is as if one should impeach the orthodoxy of Saint Augustine without taking the trouble to read the *Retractiones* of that great controversialist, or as if one should find the head and front of an author's offending in one or two passages contained in the body of a book without noting that the offending paragraphs had been corrected in the "errata" at its end. Even the literary redundancies of other men have been laid at the door of Malthus; as, for instance, when Wordsworth, in his Thanksgiving Ode after the battle of Waterloo, sang of carnage as "God's daughter," it was supposed that he drew this lurid phrase from the dogmatics of Malthus.

So much for the form in which the doctrine of Malthus made its first appearance. Let us now examine its substance in the light of his own revisions and in the light of later scientific criticism.

The expansive power with which population, as conceived by Malthus, has a general tendency to increase in every stage of culture within given territorial environments, may be roughly likened to the pressure of an elastic spring coiled within the containing limits of a box constructed with movable sides and so adjusted that the spring acts with a varying radial pressure on the containing sides, while the movable sides themselves sometimes expand and sometimes contract under other influences than those due to the tightening or relaxing coils of the spring. In this rude figure the constant radial pressure of the elastic spring represents the constant tendency which population has to increase beyond the means of subsistence, whether that tendency comes to effect or not. The expanding or contracting sides of the containing box represent the expanding or contracting forces of the food-supply in any given stage of culture and

in any given geographical limit; and it is further assumed that these movable sides sometimes expand and sometimes contract under other influences than the tightening or relaxing pressure of the spring, because, as a matter of fact, it is known that the food-supply is not always and everywhere a constant function of the numerical population, but varies according to other conditions of time, place, and circumstance. Malthus is very explicit on this latter point. "If hunger alone," he says, "could have prompted the savage tribes of America to change their habits in favor of more plentiful modes of procuring subsistence, there would not have been to-day a single nation of hunters and fishers remaining." "It is evident," he adds, "that some fortunate train of circumstances, *in addition to this stimulus*, is necessary for the purpose, and it is undoubtedly probable that these arts of obtaining food will be first invented and improved in those spots which are best fitted to them and where the natural fertility of the situation, by allowing a greater number of people to subsist together, would give the fairest chance to *the inventive powers of the human mind*." * And if mere want by its sole and single pressure never leads to a change of customs and of social levels in favor of more abundant food-supplies within given limits, it is equally true that mere ease of subsistence, by its sole and single relaxation of the Malthusian pressure, does not necessarily lead to an increase of civilization, but, in the strict causal nexus of that fact alone, may simply lead to an increase of population multiplying on the same grades of culture as before. John Stuart Mill has pointed this moral in the most offensive way when, in his narrow discussion of this topic, he adventured to say that the rapid multiplication of population in these United States, notwithstanding what he is pleased to call "some incipient signs of a better tendency," had simply led to an increase of men given to dollar-hunting and of women given to the breeding of dollar-hunters.† Equally express, though much more decorous, is the language of Malthus under this head, when he says that "a certain degree of security [it is social security of which he speaks] is perhaps still more necessary than richness of soil" to encourage the change of a people from a lower stage of culture to a

* Malthus: Principle of Population, vol. i, p. 90, edition of 1817.

† J. S. Mill, Prin. of Pol. Econ., vol. ii, p. 337; cf. vol. i, p. 212.

higher.* And in his "Principles of Political Economy" he shows how an increase of food command may work *either* for a simple increase of population *or* for an improvement in the modes of subsistence, "without a proportionate acceleration in the rate of increase." This latter working he ascribes to civil and political freedom in conjunction with education.†

It will be seen, therefore, that in the idea of Malthus the sliding sides of the box, which, figuratively speaking, comprise any given food-supply, do not expand or contract so much under the lessening or increasing pinch of the physical craving for food as under the lessening or increasing force of the radial pressure stored in the "inventive powers of the human mind"—powers which exemplify and embody the "progressional force" of civilization, and which come to the front when that progressional force is placed in effective combination with felicitous surroundings. We should not wonder that the opponents of Malthus have often failed to credit him with a due allowance for this primary principle of causation in social progress (in which cause perpetually becomes effect and again turns effect into cause), because Malthus himself has often failed to take this principle into account in checking the too absolute logic with which he pits the law of population against the law of food-supply, as if these two great and opposing protagonists filled alone the lists of the world-struggle. Yet this concession is the key of his whole position in what we may call the revised and amended Malthusianism of the later period, and it is to-day the keystone of the whole arch on which the fabric of a sound philosophy of population must rest for its historic support and scientific defense. At the very threshold of his argument Malthus deplores the fact that though the law of population had been powerfully operating since the very commencement of human society, its natural and necessary effects had been almost totally overlooked until he made them an object of special study. They were overlooked because they had been and still are complicated with so many other causes and effects in the social sphere, and it would have been better for Malthus if, in disengaging them from this complication for purposes of special study, he had more clearly recognized their organic connection with the whole social environment. In fact Malthus often fails to

* Malthus, Principle of Population, vol. i, book 1, ch. 7, p. 184, ed. 1817.

† Malthus, Prin. of Pol. Econ., chapter iv, sec. 2.

see the mixed and contingent relations between population and food-supply, because he treats his thesis too abstractly and not with a sufficient perception of its complex relations and bearings in the actual figure of concrete society, with its thousand actions, reactions, and interactions, *besides* those of population and of food-supply. In every existing stage of culture which the world has yet seen there are, indeed, "checks which have repressed the superior power of population and kept its effects on a level with the means of subsistence," and it may be that these checks, as actually interposed between the two countervailing tendencies with which Malthus deals, have all been resolvable into "moral restraint," on the one hand, preventing the genesis of a redundant population, and "vice and misery," on the other hand, reducing a redundant population to its necessary level. But the "thundering loom of Time," as Gœthe calls it, works with a thousand whirring spindles besides these in weaving for men the garment of a growing civilization. The complex forces of the body politic, though compelled, indeed, to account with the law of Malthus at every stage of culture, are not put in sole subjection to it. In falling against Malthusian law these forces, for the want of a due coördination, may have been often broken, and the law in falling on them may have sometimes ground them to powder, but there is no imperious destiny which remorselessly ordains that this shall always and everywhere be the inevitable result of an inevitable conflict. Both the conflict and the result may, in a measure at least, be avoided by the progress of civilization, for, as a matter of fact, the whole history of the human race may be cited to show, as indeed Malthus is frank to admit, that there *are* causes from without, in nature, which conspire with causes from within, in the mind of man, to break the cast-iron moulds of a stationary state in which population tends, it is true, to stand at the level of the food supply, because it shares in the lack of that progressional force which, in a growing civilization, is the secret spring of its growth and the index of whose pressure is the measure of that growth. How the growth of civilization is related to the pressure of the law of population and of food supply we may easily see in the pages of that comparative history which reveals the diminishing range of the law with each advance in the evolution of human culture.

In savagery the radial pressure of the law is seen in a simple tendency to work for the geographical diffusion of a thin and feeble

population moving on lines of least resistance over the next most accessible parts of the habitable globe. The force is weak and simple because as yet it shares in the fates of a weak and simple stage of culture. The checks on population here come speedily and they come with unrelenting force.

When, through the combination of certain inner and outer factors lending themselves to the genesis of a higher social status, the pastoral system of culture came to create a new set of emotions, a new set of social ideas, and a new species of property rights, we shall find the radial pressure of this law expressing itself in a new order of conflicts and a new variety of competitions; to wit, in frequent quarrels about the limits of pasture grounds, in sudden migrations of herdsmen moving with their flocks on lines of least resistance to fresh woods and pastures new, and sometimes in sudden raids made by an impoverished horde on the richer fields of their neighbors. The law of Malthus is indeed at work in helping on these nomadic and predatory incursions, but it works only as part and parcel of the whole social state in which it inheres and is not the sole determining principle which actuates or arrests the general social movement. There has been an advance in the social movement as compared with savagery, and *pro tanto* with this advance the law of Malthus has fallen into the back-ground, though it comes to the fore again so soon as the limits of the new social evolution are reached by the recurring pressure of population.

In favored spots, like those of the Nile Valley and of the Euphrates country, in rich river beds like those of the Yang-tsi-kiang, in comparatively fertile regions like Mexico and Peru, in which latter countries, as Malthus says, the wild Indians were "led to improve and extend their agriculture," we witness a considerable growth in the density of the population as compared with the lower status of savagery, though here again the law of population comes to assert its presence so soon as the limits of the new social evolution have been touched by the expansive force of population over-passing the expansive forces of the human mind.

In countries of the highest civilization which has yet been reached, armed with the resources of the best government, purest justice, truest morality, soundest economy, and most fruitful science attained by men, we find the greatest density of population, because the limits of population revolve more and more within the sphere of man's material, mental, and moral freedom, though the law of

Malthus is still here as part and parcel of the more complex civilization with which it is integrated. But, working as it does in harmony with this integration, it tends, along with an increase of population, to work for a higher standard of public morals *pari passu* with a higher standard of public comfort.

The moral of this survey points itself. It is seen that the forces of a growing civilization are adequate to outweigh all the manifestations of the repressive power of population which the world has thus far witnessed in each lower stage of human culture, and that for the future growth of population, alike in numbers and happiness, there is a limitless vista opened (though not an absolutely unlimited one) for the prospective working of better laws, purer justice, wiser economics, richer science, and higher morality. It is for a better combination of the forces which mark the exponents of civilization that the human race in its file-leaders is darkly striving to-day, and striving darkly because it has not yet caught the teleologic principles which should be the guides of its rational selections in social science, and so it suffers itself, in wide fields of political and economical activity, to fall an easy prey to the brute forces of that "natural selection" which perpetually expresses itself in the vegetable and animal kingdom. The term "natural selection" is here used in deference to its conventional meaning, though I deny the exclusive applicability of the term to the selections of plants and animals, because the more rational selections of man are just as natural to him as the unconscious selections of plants and animals are natural to them. The difference consists in the greater or less degree of conscious purpose which lies at the bottom of social evolution—a conscious purpose being wholly absent in plants and animals and a conscious purpose being more or less present in the natural selections of man according as he raises his intellectual and moral nature to the levels of a higher and higher humanism, his selections here becoming more and more volitional according as he gains a wider control over the laws of the nature below him, and becoming more and more rational according as he gains a deeper insight into the teleology of his own actions, and becoming more and more moral according to the degree in which he attains to the altruistic conception of his being and place in the social world. In the terms of a rigorous logic, the so-called "natural selections" of plants and animals are simple effects, not causes. Man alone is a creative cause, working above and beyond the nature

below him, and his creative causality comes to its highest expression in the social cosmos.

Malthus saw clearly enough that without a tendency in population, at least in the primary stages of human evolution, to increase faster than food, the habitable parts of the earth would never have been replenished with human occupants, but he did not see as clearly as he might have seen that in the progress of civilization the dead weight of this pressure is abated, and that the pressure itself, though not abolished, is lifted into a higher range of spiritual forces, where it works *with* the humanities and works for their extension and purification by pointing to the perpetual necessity of an ever-expanding justice and enlightenment to meet the ever-expanding forces of population, not only in point of numbers, but also in point of growing material, intellectual, and moral aspirations.

In the history of the globe thus far its population has never been limited by the food-supply which is possible, but by the food-supply which is actual, and hence it follows that the number of the population has never been necessarily limited by pure and simple considerations drawn from the food problem but by all the manifold and multiform causes which have stood and still stand in the way of realizing the greatest food-supply that is possible. Captain Cook records that the people of each hamlet and village among the natives of Queen Charlotte's Sound importuned him by turns to destroy the village next to them, insomuch that he must have extirpated the whole race if he had followed their advice.* The request was in entire keeping with the social status of savagery. The maxim of savagery is "kill and let kill," for this with savages is at once the law of self-preservation and of nature. The maxim of civilized public economy is or should be "live and let live," for the greater the number of people armed with a higher civilization the greater can be the division of labor which will be profitable, and the greater the division of labor the surer will be the conditions of food-supply, because the broader will be the basis of that unstable equilibrium which keeps the forces of society in perpetual oscillation as the secret of social security and of social progress. By plagues and by epidemics, by wars and by famines, nature seemed, in the eye of Malthus, to be proclaiming that population

* Malthus, book i, chap. 5, p. 99, ed. of 1817.

was increasing too fast for the means of subsistence, but the proclamation of nature was really levelled at a bad political and social economy, for just in proportion as this bad economy has been rectified the thin population, with the misery and violence which thinned it, has given place to a comparative density of population associated with a comparatively higher degree of happiness and peace.

In the light of this review it seems demonstrable that with each advance in civilization the onus of the food-supply problem, considered in relation to population, has been transferred more and more from the domain of physical law to the domain of human policy and rational adjustment under improved methods and institutions invented to meet the requirements of a denser population. In savagery the adjustment is imposed more from without than within. The savage lives in almost total subjection to physiocratic law. The civilized man seeks more and more to emancipate himself from the thraldom of physiocratic law, and, in proportion as he does so, the conditions of freedom, plenty, and happiness are created for growing numbers within the same geographical limits. A civilized people can lay the whole world under contribution, and this power to lay the whole world under contribution not only for commodities but also for ideas is to-day the great lever power of social change as well as of economic self-preservation.

As civilization advances a constant shifting process goes on in the number, quality, and arrangement of its elements, in the intensity and composition of its regulative and constituent forces, and in what we may call the specific gravities of its products. The records of this process are found in that vast secular sedimentation which has made the history of primeval ages a history of obsolete customs, obsolete laws, obsolete ideas, and obsolete economics. Human slavery gave a spur to culture and production in a stage of social evolution higher than that from which it rose, which did not admit of even this low and rudimentary division of labor; but slavery becomes the greatest of all obstacles to both culture and production in a stage of social evolution which is ready and ripe for a higher and more articulate division of labor. "Canoeing," which for the red man of Columbus's day meant business, means diversion for the gilded youth of our age. The luxuries of life two hundred years ago are to-day among the commonest necessaries. The ocean, which was "dissociable" in the days of Horace, is

to-day the pathway of international commerce and the very tilt-yard of international comity. The insular Britons, once almost separated from the whole world, have become the common carriers of mankind. As the nations of the earth draw nearer to each other they tend to assimilate more and more in their political institutions. As they assimilate in their political institutions they tend to assimilate more and more in their economic policies and their juridical ideas. "As two vibrating chords," says Hadley, "when brought together tend to vibrate in unison, so the commercial rhythms of separate nations tend to uniformity as distances are annihilated."* International law is to-day the highest expression of international altruism, but this altruism is constantly widening the scope of its influence. Political economy tends more and more to "inosculate with politics and the philosophy of social life," to use the phrase of De Quincey.† Restrictive systems, which once converted the nations of Europe into so many belligerent communities, fighting with hostile tariffs where once they fought with stones and clubs and cross-bows, are slowly abating in their virulence. "Every obstruction to a free exchange of commodities," says the Hon. John Sherman, "is born of the same narrow and despotic spirit which planted castles upon the Rhine to plunder peaceful commerce. Every obstruction to commerce is a tax on consumption; every facility to a free exchange cheapens commodities, increases trade and production, and promotes civilization." ‡ This doctrine is in perfect harmony with the growing unification of the nations in ideas and interests, and it is because of this unification that the civilized nations of the world, with increasing numbers, are able to protect themselves from famines and to succor the famishing in other lands. In the freedom of a world-wide trade based on the most expedient application of human labor in every land the world would find its best safeguard against Malthusian fears; and the doctrine of *laisser-faire* must, therefore, have its place in all Malthusian discussions so long as there are any restrictions—political, juridical, or economical—which interfere with man's right to the negative freedom of being let alone.|| But wherever or whenever this right has been reached, in whole or in part, the foundation has been laid

* Hadley, Capital and Population, p. 92.

† De Quincey, Logic of Pol. Econ., p. 145.

‡ Report of Committee No. 117, 2nd sess. 40th Cong., June 9, 1868.

|| Cf. Bonar, Malthus and his Work, p. 201.

for the achievement of that larger positive freedom which takes its color and direction from the initiative of the collective national mind consulting for the common weal in widening spheres of public administration.

It is because the United States throughout their broad continental dimensions give full play to free-trade among themselves that the restrictions which have been laid on their commerce by tariff acts from the days of Alexander Hamilton down to the present time are almost inappreciable; insomuch that next to the difficulty of making an argument *for* protective tariffs in the United States is found to be the difficulty of making an argument *against* them, so obscure is their practical effect for good or for evil in the presence of a continental free-trade among nearly sixty millions of the most enterprising members of the human race. And what is true for the United States, because of the continental free-trade they enjoy among themselves, is made proportionately true for all civilized nations by the rising tides of that reciprocal commerce which tends to drown out the practical effect of restrictive systems, however zealously any such nation may seek by tariff laws to beleaguer its own cities and blockade its own ports. The starving effect of such restrictions is greatly neutralized by the inevitable reciprocities of international trade.

While, therefore, a boundless increase of population throughout the globe is unthinkable, because the earth we inhabit is a bounded sphere, it is plain that absolute want of food has never yet put a necessary limit to the growth of population in the world, and that for ages to come a growing civilization ought to be able to cope with the pressure put upon it by a growing population. By comparing the small population which once pined in savagery with the large population which to-day, under civilization, subsists with comparative comfort and even opulence within the same limits, we see that the law of Malthus, so far as it presses at all, presses for more enlightenment, for more wholesome morals, for more political freedom, and for sounder economic policies before it *need* to press for the limitation of population. In this view a British economist has not scrupled to say that the conditions of the problem being what they are to-day, "an increase of population is an evil only where a nation lacks brains." The time may come when any further increase of population on this globe will be physically impossible, but it will be time enough to cross that river when we come to it.

We are threatened, it is said, with a famine of coal for our steam-engines and fire-places, but nobody for that reason burns less coal in his grate.

Let us, then, briefly recapitulate the salient points of this review. The first radial impact of the principle of population, working in harmony with the repellent forces of savagery, tends to the speediest possible diffusion of population throughout the most accessible parts of the habitable world.

The next impact of population works in harmony with the more aggregated forces of nomadic life, and tends to generate a new mode of popular migrations, new methods of societary competitions growing out of the new social organization, and a new species of warfare which differs from that of savagery not only in its weapons and objective points but also in the greater degree of conscious purpose with which weapons are wielded and social aims are pursued. The pressure from being simply *ex*tensive has also become *in*tensive.

The radial impact of populations differing in grades of culture, and which come into collision with each other, expresses itself in a new order of political contentions, giving a still higher significance to the struggles which anciently arose between nomadism and the immature civilizations exposed to its encroachments, as when Scythia let loose her predatory hordes for the desolation of Asia and Europe. And sometimes the shock of the impact arising between differing forms of specialized government is seen to lead to still more tremendous issues, as when the crude imperialism of Persia broke itself against the democracy of Greece on the plains of Marathon, or as when this imperialism was finally ground to powder by that same democracy after it had been welded into a militant propagandism by the martial genius of Alexander. In these huge games for competing empire the pressure of populations played its part.

In the petty city states of Greece, where, because of their narrow limits, all the fires of civil and social discord were kept at a white heat as in a reverberatory furnace, the law of population soon expressed itself in that growing "disinclination of the higher classes to trouble themselves with wife and children," to which Polybius traces the decline of Greece, but which in truth was only one of the manifold other signs which marked the decadence of Hellenic culture.*

* Mommsen, Hist. of Rome, vol. iii, p. 61.

Rome at different stages in her conquering career ran through the whole gamut of the Malthusian scale, and all the notes of that tragic chorus, from the day when *proletarius* (or child-producer) had been a term of Roman honor, down to the day when childlessness became the tradition and badge of patrician self-indulgence, have been caught up for us in the pages of Mommsen almost as expressively as in the Satires of Juvenal.*

During the middle ages population was held in check by that excessive inequality of fortunes which was structural in the feudal system, with its laws of primogeniture, with its enslavement of labor, with its social insecurity, with its petty commerce a monopoly, with its tax on every landed product, with its money held as the weapon of usury, with its wasting epidemics growing out of unsanitary social conditions, and with that coarse luxury of the rich which constrained to profligacy on the one hand and celibacy on the other.† Even the Italian republics, which rose on the ruins of the feudal system, did little more than play over again "the tragedy of ancient Hellas," with all the circumstances of inveterate hatred, unjust ambition, and atrocious retaliation intensified on a bloody theatre to embitter the struggle for communal existence.‡

Each age of the world and each stage of human culture brings with it, we see, an impact of population which expresses by its pressure the greater or less degree of the compound factors which enter into the composition of each epoch. The age and body of the times determine the nature and the degree of the pressure.

Malthusian law at the highest stage of culture which has yet been reached in any nation would seem to work at first for political reform, then for juridical reform, and lastly for economic reform under the guidance of sociological science. When England repealed her corn laws, in order to give cheaper food to the operatives in her manufactories, it was simply because in her then existing conditions more corn could be raised by weaving cotton and woollen cloth than by sowing wheat and rye. The impact of population, working in harmony with the mercantile polemic of Huskisson, the law reform polemic of Brougham, the economic polemic of Cobden, and the political polemic of Sir Robert Peel, resulted in a redistribution of the forces of production in England—a redistribution

* Mommsen, Hist. of Rome, vol. iv, p. 619.

† Cibrario, Economia Politica del Medio Evo, vol. ii, p. 4.

‡ Cf. Koeppen, World of the Middle Ages, p. 135.

which has made the food-supply of England more stable than ever before, as Mr. Giffen shows, though its centre of gravity falls outside of the British soil. With every such redistribution of economic forces, if an increase of production results from it, there will be an increase, *pro tanto*, of population (unless its whole force is spent in raising the grade of civilization) until a new equilibrium between population shall be reached and shall come to generate a new class of problems with which to tax the statesmanship and the science of a succeeding generation. To-day, in all the civilized lands of the world, the greatest pinch of the Malthusian problem must be sought not so much in methods of food production as in unproductive methods of food consumption and unscientific methods of food distribution. There is plenty of food in Europe, if there were not so many non-producing soldiers to take the bread out of the poor man's mouth. There is plenty of food in the United States, and if, notwithstanding the almost magical facilities which have here been created for its distribution (so that a barrel of flour can be moved 1,000 miles for 8 cents),* there is still complaining in our streets, we must look for the source of that complaining in other quarters than in a paucity of food production. That there is no want of working capacity on the globe for either the production or distribution of all the food that would be required to sustain a greatly increased population, while at the same time providing for the embellishment of our existing culture, would seem plain from the following facts and figures relating to a single branch of modern economics:

According to the computations made by the German statistician, Dr. Ernst Engel, from the best and fullest materials at his command in the year 1881, it appears that the number of railway locomotives then in existence was 150,000, representing a steam horse-power of 45,000,000. As the statistics of Prussia show that other applications of steam in that country amount to an aggregate horse-power equal to half that expended on railroads, the same ratio, if holding good throughout the world, would yield a total horse-power of 67,500,000 resulting from steam alone. And as each steam horse-power is estimated to be equal to the working capacity of 2.55 living horses or of 14.85 adult men, it follows that the total steam power of the civilized world at that date was equal to that of 172,125,000

* Edward Atkinson, Century Mag., Dec. 1886, p. 239.

living horses or of 1,002,375,000 laboring men. But, as the power of the hammer is effectuated by the anvil upon which it strikes, so the power of the steam-engine derives its force and effect, its working capacity, from the appliances by which it is *potentiated—i. e.*, from road-beds, rolling-stock, &c., in railroads, and from fly-wheels, cog-wheels, spindles, &c., in manufactories. According to the data gathered by Engel it appears that this nominal power of steam-engines is increased from forty-five to fifty times by virtue of these appliances, and estimating the increased potentiation at the average of forty-seven times we shall have, from railroads alone, a working capacity equal to that of 5,293,250,000 living horses or of 31,407,750,000 laboring men. And, as other applications of steam amount to half these sums, the total steam power of the world, represented in living horses and laboring men, would be equal to that of 7,939,875,000 living horses or of 47,111,625,000 laboring men—figures which err on the side of defect rather than of exaggeration. As the population of the civilized nations of the globe is about 400,000,000 it will be seen that steam alone would place at the disposition of each individual in these nations a working power equal to that of more than 117 men if the power were used up to the full height of its potentiality and if it were equally distributed. The headlight of a locomotive is the Aladdin's lamp of this nineteenth century, with thousands of genii attached to each light ready to do the bidding of man, instead of one, as in the Arabian tale. With such vast reservoirs of productive capacity to draw upon, the human race has no right to cherish Malthusian fears, for this reservoir is only one of the many others created by the inventive powers of the mind and is as yet imperfectly utilized.

The radial pressure of population, as determined by the relation between the supply of food actual and the supply of food potential, becomes, therefore, a sort of weather-gauge by which we may measure the thermometrical and barometrical pressures of the political atmosphere in which we are living—the temper of mind with which a nation confronts its politico-economical problems and the solid weight of the intelligence and justice which it brings to their solution. The Malthusian index is a danger signal which calls for precautionary measures of an affirmative character in political, juridical, or economic reform—it may be in all three at once—even more imperatively than it calls for preventive checks on the growth of population, though these checks must, indeed, be applied if there

be not wisdom enough to cope with the pending problems by the adoption of positive measures. And as prevention, whether it be prevention in the way of vice and misery or prevention in the way of voluntary restraint, is here of easier application than the exercise of new inventive powers or the creation of new executive powers in the figure of human society, we should not wonder that Malthus taught as a philosophy what all men and all nations have been so ready to practice as a make-shift and expedient, instead of laying a new exaction on their positive science of government and instead of working out a new and better composition of social forces in their executive administration. If the day should ever come when food enough for the human race, even under the reign of universal justice and of universal science, could not be produced by any new division of labor, by any further intensification of the forces of production, by any new redistribution of the economic forces, or by any additional facilitation of economic exchanges, *then*, so far as we can now see, the Malthusian pinch would have come indeed, and would have come to stay.

DISCUSSION.

The preceding paper by Dr. WELLING was read at the meeting of the Anthropological Society of Washington held on February 1, 1887.

At the close of the reading Mr. LESTER F. WARD spoke as follows:

The law of Malthus furnishes an illustration of the tendency to attack the higher and more complex problems before studying the lower and simpler ones. Malthus framed a law which was applicable to animals below man and to plants, but not to man, and it was reserved for Darwin to confine it to its legitimate field. Its failure, when applied to human beings, is due to the existence in man of an element only foreshadowed in the highest animals—the psychic element, the intellectual, or inventive faculty. Through this faculty men have the power of completely destroying the relations between the law of population and that of subsistence by regulating both—*i. e.*, by limiting the former and augmenting the latter. Thus far, however, it has been chiefly by the last-named method—*i. e.*, by the nearly unlimited creation of the objects of desire—that this result has been accomplished, and but for the barriers to the

equitable distribution of the products of thought and labor, to which I have called attention on previous occasions, there could never be any danger that population would outstrip the means of subsistence. This is strikingly shown by Dr. Welling's illustration of the enormous mechanical power now wielded for man's benefit by the great agency of steam. Almost any other of the modern agencies would have shown the same truth. But the objection might be raised that these are, at most, only accessory to the production of subsistence, which must primarily come from the soil. Even to this it may be replied that we have as yet scarcely begun to economize the resources of the soil. Experiments already made demonstrate that the earth is now made to yield only a small fraction of what science and skill can obtain from it, so that this apparent limit does not exist in reality. Production—the power to create the means of subsistence—is thus practically unlimited, and the only real limit is that to population itself. The massing of population so densely as to render the entire habitable globe one vast city, though all could be shown to possess an abundant supply for their needs, would be undesirable. But this problem must and would be solved by the application to it of the same great power which man possesses to the exclusion of every creature below him—the power of mind exercised in rational restraint and in the control of the laws of reproduction. The character rather than the number of offspring would, according to a law already manifest in society, become the chief concern, and it would ultimately be the quality instead of the quantity of the population that would continue to increase.

While, therefore, it is intelligence that exempts man from the operation of the Malthusian law, still we find intelligence itself subject to an analogous law of its own. The social system of the savage is comparatively simple, and little intelligence is needed to adapt the individual to it. In civilization this system becomes complicated and intricate, and a great amount of intelligence is required of each citizen to subsist within it. Only by knowing what are the principles underlying the social system, and becoming acquainted with the manner in which they operate to sustain and carry it on, can any member of society be useful or anything but injurious to his fellow men. But the civilized intellect, unprovided with this acquired knowledge, is only a short step above that of the savage. The civilized infant is as blank intellectually as the savage infant; has no longer to live and immensely more to learn. In a word,

the natural development of the native capacity for intelligence does not keep pace with the artificial requirements of the civilized state, and we have another Malthusian law, as it were, that "while in the progress of civilization the capacity to acquire knowledge increases only in an arithmetical or some lower ratio, the amount of knowledge necessary to be acquired increases in a geometrical or some higher ratio."

Mr. H. H. BLISS thought that in considering this problem there is danger of omitting factors as important as those included. Admitting that the means of subsistence increase faster than population, this does not preclude pressure. The life of the individual itself being a variable element, if it should vary in a constant ratio with the expansion of subsistence, what benefit would the weak and the poor derive from such expansion?

Prof. O. T. MASON said that in applying the doctrine of Malthus to human society, it is necessary to bear in mind that in our higher civilization we have a kind of social "house that Jack built." Indeed, we must pursue our studies after the manner of the paleontologist. If we represent the total fauna and flora of the first geological epoch by a, some of the species of this epoch will survive into the next period, so that the life of the second period would be in a rough way $a+b$, of the third period $a+b+c$, and of the modern period $a+b+c+d$. Now, in any of your great cities or cultivated communities such a state as this exists and we have, as it were, civilization $a+b+c+d$. In applying the doctrine of Malthus to one of these communities we must understand that a great deal of the dissatisfaction observed among the poor grows out of the fact that while they are themselves in a, they demand all the gratifications and comforts which have come to be the necessary concomitants of the condition d. The question, therefore, is not merely one of the pressure of population on food supply, for that has rarely failed of solution in any community as a whole; but it is constantly happening that those succumb who, survivals from a former period, are out of harmony with the condition of things around them.

The discussion was concluded by a few remarks made by the President, Maj. J. W. POWELL.

POPULATION OF RUSSIA IN EUROPE.—M. Alph. Castaing, in "Le Muséon" (vi, 31–49), makes the following divisions of Russia, as respects population: Finland, Baltic Provinces, Kingdom of Poland, Western Provinces, Little Russia, Southern or New Russia, Great Russia (Tsarats of Astrakhan, Kazan, and Muscovy). The people are classed racially:

Slavs: Finno-Sarmatians, comprising Poles, White Russians, Little Russians, Ruthenians, &c.	22,000,000
Lithuanians: Finno-Sarmatians and Aryans	2,000,000
Finns, mixed or pure	4,000,000
Turks: Ugrians, Altaians, Bulgars, Nogais, Tatars, Mongols, Kalmucks	15,000,000
Muscovites	25,000,000
Jews	2,000,000
Foreigners	2,000,000
	72,000,000

ETHNOLOGY OF BRITISH COLUMBIA.—The western coast of America from Mount Saint Elias to Puget Sound is now one of the promising fields in anthropology. Dr. Franz Boas, in the Bulletin of the American Geographical Society (xix, 225-232), devotes a chapter to the Kwakiutl stock, inhabiting the shores of Queen Charlotte Sound. A list of reserves is given for the following Indians, divided into gentes, each claiming land as its property: Quaw-she-lah (Kwa-sila), Smith Inlet; Nah-keoock-to (Nakwartoq), Seymour Inlet; Nahwitti, including Naqomqilis and Tlatlasiqoala; Fort Rupert Indians, including Kwakiutl, Walaskwakiutl, Kuéh'a, and Komkiutis; Nimkeesh Indians; Village Island Indians (Mamaleleqala and Kwiksot'enoq); Gilford Island Indians, including Tsawate'noq, Kwauoenoq, and H'ah'uámis; Knight Inlet Indians (Tenah'tah' and Ah'wah'kitlala); Turnour Island Indians (Tlautisis); Mah-tulth-pe (Matilpi); Laich-kwil-tach (Lekwiltoq), consisting of five subtribes: Hah'amatses, Wiweq'æ, Wiweaqam, Kueh'a, and Tlaáluis. A census of the nation is appended for three dates—1883, 2,264; 1884, 1,889; and 1885, 1,969.

THE DEVELOPMENT OF TIME-KEEPING IN GREECE AND ROME.

BY F. A. SEELY, OF THE U. S. PATENT OFFICE.

In my room in the Patent Office there hangs a Connecticut clock of ordinary pattern and quite imperfectly regulated. Its variation of perhaps half a minute in a day, however, gives me no concern, since, being connected by wire with the transmitting clock at the Naval Observatory, it is every day, at noon, set to accurate time. At the moment of 12 o'clock there comes a stroke on a little bell and, simultaneously, the three hands—hour, minute, and second—whether they may have gained or lost during the preceding 24 hours, fly to their vertical position. Immediately after I hear a chorus of factory whistles. sounded in obedience to the same signal, dismissing the workmen to their mid-day meal. At the same moment and controlled by the same impulse the ball, visible on its lofty staff from all the ships in New York harbor, drops, and the seamen compare their chronometers for their coming voyage. The same signal is sent to railway offices and governs the clocks on thousands of miles of track and determines the starting and stopping and speed of their trains. It goes to the cities of the Gulf and of the Pacific as well as to those of the Atlantic coast—noted everywhere as an important element in the safe, speedy, and accurate conduct of commerce; and so the work of the regulating clock of the Observatory, sent out by means which note the minutest fraction of a second of time, is playing its important part in the economy of our century. I cannot follow it out in detail; every one will do so to some extent in his own mind. But if we were to divide human history into eras according to the minuteness with which the passage of time is observed in the ordinary affairs of life we should find ourselves to have arrived, and very lately, in what might be called the era of seconds.

At the opposite extreme is the period when the passage of day and night reveals itself to the dullest intellect. Perhaps no savage people have ever been so dull as not to have noted more than this. We can hardly conceive a state in which the brutal hunter did not take note of the declining sun and observe that the close of the day was approaching. The lengthening of his own shadow was an

always present phenomenon, and men must have observed shadows almost as soon as they became capable of observing anything. But this kind of observation went on for ages without any attempt to subdivide the day, and none but the great natural periods marked off by sunrise and sunset were recognized.

Between this period, marked by the observation of the natural day only, and that in which we live, there have been many steps of progress, the very dates of which may in some cases be quite distinctly observed. We find an era where noon begins to be noted, and the natural day is equally divided by its observation. Then we find an era in which either the entire day or its great natural fractions are again divided into smaller fractions of rather indefinite length, as is now done by some savages and as was done in the earlier history of Greece and Rome. Next to this comes the era in which definite artificial fractions of the day are observed, which may be called the era of hours. It was many centuries after this before men in the ordinary transactions of life counted their time by minutes, but the time when this began is quite distinctly marked.

I would not say that these eras are contemporaneous in all nations, nor could I assert that they correspond closely with any recognized stages in civilization and culture; in fact, the observation of hours of the day does not appear to obtain until civilization is reached, This is true however—men measure most carefully that which they value most, and the value of time is enhanced just in proportion to the multiplicity of the demands upon it which the existing state of society involves. The man who has engagements at the bank, the custom-house, his own warehouse or factory, and in a court-room, and a dozen or more individuals to meet, each of whom, perhaps, has similar pressing engagements, and then must reach an express train at 4.30 in order to dine at 6 fifty miles away, must allot his time with the greatest care and measure it with the utmost minuteness. To the savage, the sun rises and sets and rises again—one day is as another; nothing presses but hunger, and that he endures till fortune brings food. He needs no clock to tell him it is dinner-time, for it is always dinner-time when there is food. When people traveled leisurely by stage coach, walking up the hills to rest the horses, stopping at the wayside inns to dine, and well content at the close of the day if fifty or sixty miles had been covered, seconds of time and even minutes were of little account; but when trains are run on a complex schedule, and for a whole season in advance

it is set down at just what place each train must be at each moment of every day, and the safety of lives and property depends on exact adherence to the prescribed order, then the station clocks must be invariable and synchronous and the conductor's watch true to the second. Civilization is marked at every step of its progress by the multiplication of the varied relations between men, and since the importance of time is enhanced by the same multiplication it may fairly be asked whether the accuracy with which time is observed in ordinary life may not after all afford one of the most perfect indications of the social condition of a people.

The material is not gathered for a full discussion of a question like this, and I shall not occupy myself with it, but as incidental to and suggested by the topic I have chosen some light seems to be thrown on it by the attempt to place in their true correlation facts of history not hitherto brought together. I have proposed to myself only a study of the growth of the common clock, noting the various steps in its development with reference to their period in history and to the social conditions which inspired or demanded them as well as to the state of science and mechanic arts which made their consummation possible. The subject is too large for a single paper, and I have therefore taken for present consideration that part which relates to time-keeping among the ancient peoples from whom we chiefly derive our civilization and to a period of history which, by a sort of coincidence, practically terminates with the beginning of our era. My guide in this inquiry will be the principles in eurematics that inventions always spring from prior inventions or known expedients, and that they come in response to recognized wants. It need not be repeated that these principles find copious illustrations in the progress of every art; but the truth cannot be too strongly enforced that the progress of no art can be intelligently studied or thoroughly comprehended without keeping them in mind.

The few barren and isolated facts that have been preserved to us regarding time-keeping prior to about 600 years ago are not enough in themselves, however carefully collated, to constitute an intelligible or consecutive history. But I need not say that no event is in fact isolated from all others in cause and effect; and if we cannot have direct light we may look to the concurrent events of history for side lights upon our meager facts which will, perhaps, throw them into stronger relief than the direct narration of unphilosoph-

ical historians. Hence, if I shall seem to any one to lean too much upon the synchronisms and sequences of history, it is not that I do not realize the possible fallaciousness of an argument which has no other foundation; but in the progress of inventions such sequences are to be sought for. Invention responds to want, and the want may originate in some crisis or event having no apparent affinity in character with the want it engendered or the invention that sprang to meet it. And these are not mere accidents: they are the natural course of what I venture to call the fixed laws of euremática. At the same time these laws do not necessarily always call for original invention, since importation of an invention already known elsewhere may equally supply the want, and historical crises are as likely to lead to importation, where it is possible, as to invention. It is with these principles in view, and always looking for such side light as contemporary events can give, that I have attempted to frame the consecutive history of time-keeping, of which this paper is a part.

There are three primitive forms of time-keeping instruments—the sun-dial, the clepsydra or water clock, and the graduated candle. The last plays no part in the evolution of the modern time-keeper, and I shall pass it by without further notice, notwithstanding some interesting historical associations connected with it. But the sun-dial was at the beginning the only time-keeper, and man's ideas, developing into wants, led to its greater perfection till these wants passed far beyond what, with its limitations, it could supply. Its contribution to the present state of the art was not large, mechanically considered, but it was enough to create the demand for something better, and without this contribution the art could not have been. The rude utensil which the Greeks called a clepsydra had no resemblance to the perfected time-piece of this century, but nothing in history is surer than that out of it, by slow accretions, science and art, by turns mistress and handmaid, have produced the masterpiece of both.

This history is, therefore, the history of a human want and of a mechanical structure developed in response to it. But wants grow, and this has grown; and in tracing it we do not find it always in the same likeness. Sometimes the want of the moment is satisfied, and then it appears in a novel and unexpected form, altered in its whole complexion by that which has just appeased it. And as we recognize this Protean character, we need not suppose that the

Babylonian astrologer who made some improvement in a sun-dial had a single idea or purpose in common with those of a railway manager who last week connected his regulator by wire with the Observatory. We trace our want in the development of institutions, in the creation of new demands upon time, in the growing complexity of human relations, in political crises, and we may determine its character or intensity by the means used to supply it and the generality of their adoption. The story of the growth of the instrument is inseparable from that of the growth of civilization.

Writers on the history of the clock (and they are not few) have generally begun by a reference to the sun-dial as a Babylonian or Chaldean invention. We can trace it no further, and have no means of determining when the invention was made. We learn from the Old Testament Scriptures that it was known at Jerusalem as early as seven centuries before our era, and the manner of its mention indicates that in that city it was a novelty. King Ahaz, by whose name this dial is called, had introduced other novelties into his capital on his return from Damascus, whither he had gone to make his submission to Tiglath-Pileser II, King of Assyria; and it is not unreasonable to suppose that the dial had the same origin. However this may be, it was a graduated instrument, having degree marks of some kind which showed the daily course of the sun. We may infer that it was at least of a Babylonian pattern, and it points to a remote period when a graduated dial indicating the time of day by a shadow passing over it was known to Oriental peoples.

Presumably it was their invention. The suggestion that they derived it from Egypt is a guess only, based on the supposed earlier growth of Egyptian science. To such a guess might be opposed the fact that in all the Egyptian monuments yet explored there is no hint of such an instrument.

The Assyrian monuments are equally silent; and the same speculation which attempts to account for the absence of all representation of a sun-dial in the sculptures which have revealed to us so much of the domestic life of the Assyrian people applies to Egypt also. We may believe that it was not a device generally known or commonly used. Very likely the knowledge of it was confined to the priests and magi, who were not only ministers of the religion of each country but the masters of its science. This device constituted a part of their mystery and was religiously kept from the public knowledge. In support of this conjecture it may be said

that the Phœnicians, who penetrated every land, dealt in every merchantable commodity, and from their active commercial habits were the very persons who would have found the use of a time-piece most valuable, do not appear to have known of any such instrumentality; but the inner temples of Thebes and Babylon were not open to those hardy mariners, and the exhumations of Cyprus reveal no more to us than those of Nimroud and Memphis.

It is scarcely profitable to grope in the darkness for the origin of the sun-dial; but certain facts are apparent and may be briefly indicated. In Egypt and Assyria observation of the heavenly bodies was a part of the religious cult. The regulation of the calendar belonged to the ministers of religion. For the regulation of the calendar, which of course involved the determination of the length of the year, the recurrence of the solstices must be noted; and these could only be noted by observation of the day when the shadow cast by the sun at noon was at its maximum or minimum. The observation of shadows for the determination of noon led (it could scarcely be avoided) to their further observation during the entire period of the sun above the horizon, and, at last, to marking the surface on which the shadow was cast by permanent lines dividing the day into some kind of regular parts. All this might be done as a matter of scientific observation without conscious need of a time-piece.

The sun-dial took many forms, and more than one of these may have been known to the Babylonians. The art of dialing involved mathematical problems of considerable complexity, and the study of this art very likely contributed to the knowledge of mathematics that the world possessed at that early period. The consideration of these forms is not germane to my present purpose, which is for the moment only to show that long before the appearance of the sun-dial in Greece the instrument had been apparently perfected by the wise men of the East.

Historians have agreed in fixing the period of the introduction of the sun-dial into Greece in the latter part of the sixth century B. C. Herodotus says it was derived from the Babylonians, from whom he also declares the Greeks to have derived the twelve parts (δυώδεκα μέρεα) of the day. Others, however, ascribe its invention to Anaximander, who is said to have set it up in Lacedæmon. It is evident that he need not have invented it, but might have brought it from some country where its use was already known. It is signifi-

cant that Anaximander and Anaximenes (to whom some writers ascribe the honor of the invention), were both fellow citizens and pupils of Thales of Miletus, and that the date of this introduction synchronizes with the extensive and intimate acquaintance between Egypt and Greece, which, commencing in the reign of Psammetichus, reached its culmination under Amasis, the fourth king of that dynasty, and in which the people of Miletus bore the most prominent part. Under this last king, whom they assisted in throwing off the yoke of Assyria, Greeks swarmed in the Egyptian court, filled her armies, manned her fleets. They passed to and fro continually; Greek philosophers pursued their studies in Egyptian schools: and who shall say how many of the secrets of art and science found their way at that time from the land of the Pharaohs to the spirited and versatile people just emerging from barbarism across the Mediterranean? Surely, if under such conditions anything of Egyptian origin or likely to have been in Egyptian possession is found to have made its appearance among the Greeks, we need not speculate as to how it got there.

It does not appear that the sun-dial was introduced to the Greeks in any perfected form. On the contrary, it was at first a mere staff or pillar (γνώμων), destitute of any graduated dial which could indicate the passage of an hour or any definite fraction of a day. The length of the shadow, measured in feet, determined the time for certain regular daily duties, as a shadow six feet long indicated the hour for bathing and one twelve feet long that for supper. More accurate and convenient forms were perhaps known to philosophers; but, if so, they did not come into common use. This simple device was sufficient for the simple habits of the people. The twelve parts of the day of which Herodotus speaks had no meaning to the Athenians, who had no word meaning specifically *an hour;* and as late as the time of Alexander, the old system seems to have been followed. This kind of observation, it may be remarked, was perfectly feasible in the shadow of an Egyptian obelisk, which may partly account for the absence of the instrument from other monuments of that country. As a matter of history, an obelisk at Rome was actually used for a sun-dial in the time of Augustus.

We learn from this history at what period and in what stage of progress the Greeks first had the idea of measuring time. If we associate it with the period of Solon, the Athenian law-giver who died about 570 B. C., we may form some idea of the condition of

the people of Athens from the character of his legislation and the miseries he attempted to mitigate. The Greeks had written language and they had literature—Homer, Hesiod, Sappho. They had a system of weights and measures and a coinage. They were prolific in political ideas. But the period just previous to Solon was marked by the tyranny of the oligarchs, the severity of whose legislation gave the term "Draconian" its significance, by widespread poverty, by slavery, by the decline of agriculture and industry, and by the unceasing war of factions. Athens was emerging from such conditions as these, under the reign of Pisistratus, at the moment when the Milesian philosopher is said to have introduced the sun-dial. We may conceive that the conditions were not favorable to the general adoption of any novelty of this character, but it is noticeable that this period was followed immediately by one of democratic ascendency under the constitution of Cleisthenes, in which the naval power and commercial importance of Athens were vastly augmented, and which continued without interruption until his invincible phalanxes laid all Greece at the feet of Philip of Macedon.

It was during this era of maritime vigor, of commercial prosperity, and of dominating influence at home and abroad, that Athens achieved that splendor in art which has made her a beacon light for all subsequent peoples and ages; and in this period time-keeping in common life had its first development. But the sun-dial is an instrument of limited capacity; however perfected, it was valueless in the hours of night and in the days of cloud and storm that even sunny Greece does not always escape. But, more than this, it was incapable of indoor use; and in the outgrowth of institutions under democratic order and among a litigious and voluble people a new and singular want had arisen demanding some means of checking time which, from its limitations, the sun-dial could not supply. With her other arts, that of oratory had developed in Athens; but every orator was not a Pericles, and whatever may have been the merits or defects of their performances the inordinate length of these was too great a tax on the tribunals. It therefore became necessary to limit and apportion the time of public speakers in the courts, and to do this equitably some practical means of indicating time was necessary. Hence arose the demand for another instrumentality whose origin and history are now to be traced.

It is proper to pause for a moment here to note a distinction between two kinds of instruments used to measure time. A continuous instrument like a clock, which marks off the hours of the day and night as they pass successively away, is what is called in common language a time-keeper; but there is a class of instruments which do not keep the record of continuous time, but are used only for the checking of brief periods; such an instrument is the glass by which the seaman observes his log or the cook boils her eggs. To such instruments, for the want of a better term, I give the name time-checks, to distinguish them from time-keepers. Their use is quite distinct from that of observing the time of day, and yet it is apparent at once that, by careful attendance, as by turning the hour-glass at the moment when its last sand has run out, the time-check may be made to perform the office of a time-keeper. The allusions of ancient writers and of some modern ones to devices of these two classes are sometimes misleading and confusing because this distinction has not been kept in view. It is particularly important in the study of the clepsydra, which is originally a time-check only, while the sun-dial is a true time-keeper.

The clepsydra or water clock, in its simplest form, is traced by historians no further than Greece, about 430 B. C., in the time of Aristophanes, whose familiar references to it show its use for certain purposes to have been common.

I confess I have been far from satisfied with stopping at this half-way house in seeking for the origin of this instrument. I have sought further, and what I have found, if conclusive of nothing, is at least suggestive.

If, taking our lives in our hands, we could step on board a Malay proa we should see floating in a bucket of water a cocoanut shell having a small perforation, through which the water by slow degrees finds its way into the interior. This orifice is so proportioned that the shell will fill and sink in an hour, when the man on watch calls the time and sets it afloat again. This device of a barbarous, unprogressive people, so thoroughly rude in itself, I conceive to be the rudest that search of any length can bring to light. It is in all aspects rudimentary. One can scarcely conceive of anything back of it but the play of children, and, as a starting point for this history, it is much more satisfactory than what is disclosed in the polished ages of Greece. There is nothing in its structure, if we were to consider that only, to prevent it from being a survival

of an age long antecedent to the use of metal. The protolithic age might have originated it if we can conceive that protolithic man could have had use for it.

Leaving our piratical friends, to whom we are so much indebted, and passing to their not remote neighbors in Northern India, we find the rude cocoanut shell developed into a copper bowl. Its operation is the same, but the attendant, who stands by and watches the moment of its sinking, now strikes the hour on the resonant metal. It is easy to see—in fact it would be difficult to doubt—that this has been an improvement on an apparatus like that of the Malay and the natural result of improvements in other arts, eminently that of metal-working. It is more enduring, more perfectly accomplishes its purpose, and is in the precise direction that improvement on the ruder appliance might be expected to pursue.

Passing from Southern Asia to a people geographically remote, I next observe the water clock in use up to this day in China. We find the metal vessel with its minute perforation as before, but it has undergone a radical change in respect to its manner of use. It is now filled and the water flows from it in drops. Obviously enough the flight of time might be indicated by merely observing when the vessel has emptied itself and then refilling it, which, as will presently appear, was exactly the simplest Greek and Roman clepsydra and differs in no mechanical respect from the ordinary sand glass.

But in the days when the Chinese were a progressive people and developed inventions for which Europe had many centuries to wait, this water clock advanced far beyond the crude thing we have been considering. It would seem that the problem was to increase its usefulness by subdividing the unreasonably long intervals required for the complete emptying of the vessel. If this was done by marking graduations on the inside of the vessel and so noting the decline of the level the difference in its rate could not fail quickly to make itself manifest. The solution of this problem, not obvious at first, was found in so arranging the vessel that it should discharge into another, where the indication would be read in the rise of the surface, and contriving to hold the water in the upper vessel at a constant level. This was done by employing a third source, from which there was a constant flow into the first equal to its discharge. As the head in the middle vessel is thus maintained constant, the rise in the lowest is made uniform. Another radical improvement

enhancing the practical utility of the device was the arrangement of a float on the surface of the water in the lowest vessel. Upon this was an indicator or hand which, in its rise, traveled over an adjacent scale, and so gave a time indication visible at a distance.

To show what progress this structure implies in the development of the mechanical clock it is worth while to glance a moment at the essential elements of such an instrument. Reduced to its lowest terms a clock consists of three elements only. These are a motor, or source of power, represented in our clocks by a spring or weight; an escapement, or a means by which the stored power in the motor is let off at a measured rate; and a dial, which is but the means by which the rate at which the power is let off is made visible to the eye. In this Chinese water clock we discover all these elements. Water, acted on by gravity, is a familiar form of motor; the small perforation through which it slowly trickles drop by drop is a true escapement, doing in its place just what our complicated mechanisms are doing in theirs; and, rude as it may appear, it is one which mechanicians of our time are not ready to dispense with. The visual indication is given by the rise of the float, causing the pointer to pass over the scale. Going backward from this Chinese clock we perceive, but less distinctly, the same elements in the Indian and Malay devices, in which the operation is reversed. In these the weight of the vessel, held up by the resistance of the water in which it floats, is the power; the perforation admitting the water by slow degrees is the escapement, and the only indicator is the visible sinking of the vessel itself.

The three devices described correspond in the degree of their perfection with the conditions of art and culture among the peoples to which they belong; and, as these conditions appear to have been unchanged for a long period, we hazard little in assuming that they date from a remote epoch. A description of the Hindoo instrument appears in a Sanscrit work on astronomy in which it is adopted for astronomical observations, and Chinese writers do not hesitate to ascribe the invention to Hwang-ti, who flourished, according to their chronology, more than twenty-five centuries before our era, and its later improvement by the introduction of the float to Duke Chau fourteen centuries later.

In describing these three devices in the order in which I have placed them I do not mean to be understood as intimating that they have followed the same order in respect to the time of their develop-

ment nor that they have been transmitted from one people to another in the same order. I have, for convenience, proceeded from the lowest form to the highest; but it may well be true that the lower was an adaptation from the higher, fitting it for coarser needs, and so being in a certain sense an improvement. Consideration of the lines of commerce might, in fact, lead to the suspicion that the Malay got his notions from the Chinese, since they must for many centuries have sailed the same waters and been in frequent contact.

But we may come further west. Writers on this subject, while attributing to the Chaldeans the invention of the sun-dial, do not generally accredit them with the knowledge of any other instrument for measuring time. But if we may take as an authority Sextus Empiricus, who wrote near the end of the second century of our era, they had, as he tells quite minutely, the same device and used it in their astronomical observations. "They divided," says this author, "the zodiac into twelve equal parts, as they supposed, by allowing water to run out of a small orifice during the whole revolution of a star, and dividing the fluid into twelve equal parts, the time answering for each part being taken for that of the passage of a sign over the horizon." I see no reason for doubting this. In fact the division of the zodiac into twelve signs seems to require a means of measuring the passage of time at night, and this fact and the story just quoted tally with the conclusion that an instrument of the common generic character borne by all the forms I have described was known among widely distinct peoples of Asia before the dawn of European civilization.

Such an invention is not likely to be lost by political changes while supremacy in the exact sciences is maintained. We know that down to the Medo-Persian conquerors of Babylon each successive dominant race adopted, as has often happened in history, the dress, the manners, and the arts of the conquered; and we need not doubt that this instrument was in use in the Persian Empire when its sword first crossed that of the Greeks.

No record exists of the introduction of the clepsydra into Greece. We might infer from the absence of all reference to it by Herodotus that up to the period when his history ends, 478 B. C., it was not known. Fifty or sixty years later, when Aristophanes was writing his comedies, it was absolutely familiar in Athens. The interval named seems short in accounting for so radical a change in the habits of a people as is implied by the general introduction of such an appli-

ance; and yet, if we ask ourselves as to the condition of the electric telegraph or the sewing-machine fifty years ago or of the telephone ten years ago, it need not startle us to conceive that a versatile people like the Greeks were capable of as swift changes in their habits of life as these inventions have induced in ours. That this epoch saw more than one change in Athens, in the aspect of the city, in the habits of the people, and, above all, in their advance in culture and refinement and the arts of peace, we may be sure when we remember that it includes all the years of Pericles's administration. It includes, also, the abandonment by Sparta, always unprogressive, of the leadership of the Greek commonwealths, and with this abandonment the removal of the reactionary influences hitherto a clog to the enterprise and prosperity of Athens and of all Greece.

In the absence of data on this subject it seems not unreasonable to believe that the knowledge of the clepsydra, which was widely spread among Oriental peoples, was introduced into Athens from the East during or at the termination of the second Persian war; and, if we choose to surround its introduction with the halo of romance, it is not hard to conceive that these useful devices of civilization were gathered up among the spoils of Platæa or washed ashore with the wrecks of Salamis. A more commonplace and not less likely conjecture would be that the instrument was already becoming known in the Greek colonies of Asia, and, perhaps, even in Athens herself, through intercourse with the Persians and other Oriental peoples. It came into common use in obedience to the want, not of a time-keeper, which was already supplied, but of a time-check—a want created by the conditions of Athenian society which I have already described and which the only known time-keeper could not satisfy.

If the increasing burden and tediousness of litigation led to the enactment of a statute restricting and apportioning the time of speakers in the courts, and providing this means for its regulation, it is easy to see that the use of such means must become at once familiar. I have found no trace of such enactments, but that strict ordinances existed there is no doubt. We know that the time of speakers was carefully proportioned to the importance of the case; and trials of importance enough to have the time apportioned were known as πρὸς ὕδωρ, while those of trifling importance, in which, perhaps, no lawyer appeared, were known as ἄνευ ὕδατος: two terms which may be freely rendered *wet* and *dry*, the dry case being as it happens most quickly

disposed of. In a case of great moment to the state, involving a charge of faithlessness in an embassy, each party was allowed 10 amphoræ, or about 50 gallons of water. Nothing, however, seems to be known of the actual length of time indicated by this quantity of water. A passage in Aristotle gives some idea of the form of the clepsydra as commonly used; it was a spherical bottle with its minute opening at the bottom and a short neck at the top, into which the water was poured. The running out of the water at the bottom could be stopped by closing this neck. In using the word bottle I do not mean to imply that this clepsydra was of glass. Glass vessels of a suitable size could not be made at that period.

The familiar association of this device with the courts is shown in many ways. Aristophanes throughout his comedies is in the habit of using the word clepsydra as a synonym for court of justice, and in a humorous passage in *The Wasps* the impossibility of conducting a trial without it is quite forcibly set forth, by the introduction, to supply its place, of a vessel intended for less refined purposes. In fact, ὕδωρ became a synonym for time. We find Demosthenes charging his opponent with talking ἐν τῷ ἐμῷ ὕδατι, "*in my water*:" and on another occasion he shows the value he attached to the ti allotted to him by turning to the officer, when interrupted, with a peremptory σὺ δὲ ἐπίλαβε τὸ ὕδωρ, "*You there! Stop the water!*"

I shall again have to refer to this use of the clepsydra when I come to the Roman period of this history, and will not follow it further now; nor shall I consider its use as a time-keeper, which, if ever general in Greece, was not until a very late period, belonging, rather, to the Roman chapter also. The story that Plato had a clepsydra which indicated the hours of night is of little moment, although it is frequently taken as indicating some kind of a striking apparatus; but the language of the author who is the only authority for the statement contains no allusion to an audible signal, nor in fact any intelligible allusion except to a larger clepsydra than usual.

In fact, all the improvements by which this instrument was converted into a time-keeper belong to so late a period of Greek history that it is more convenient to consider them further on.

Where Greek colonies were founded and where Greek influence predominated Greek arts and culture flourished also. Under the Ptolemies Alexandria became a second home of art and science not inferior to Athens herself. To a greater or less extent the same must have been true of the great cities which dotted the northern

coast of the Mediterranean, such as Tarentum, Agrigentum, and Syracuse. With kindred people, similar culture and needs, and with unceasing commercial intercourse, there is no reason to doubt that whatever was in common use in the mother cities found its way to them also. It was in Alexandria that in the shape of what is appropriately termed the water clock the clepsydra attained its highest development, in the inventions of Ctesibius, who is placed by some writers in the third century B. C. and by others with more probability in the second. I reserve these inventions also for the latest epoch in this history, to which they seem more properly to belong, and will now pass to Rome.

There is no reason to believe that the Etruscan people, with all their proficiency in certain arts and a vigorous and extensive maritime commerce, possessed any artificial means of indicating time. If they had, it could hardly have failed to come into use among the Romans, whose relations with them for centuries were close, even if generally hostile. But it was not till a late period, long after Etruria had been crushed under the successive assaults of her northern and southern enemies, that any device of this character was known to the people of Rome.

Indeed, the condition of society and of the arts in Rome at that era was not such as to require any reckoning of the time of day beyond the observation of sunrise and sunset. In the twelve tables, which date from the middle of the fifth century B. C., noon also is mentioned. But the facts that history has preserved to us show that the Romans of that time were a thoroughly rude and almost barbarous people. It was not till two centuries later than this, in the year of Rome 485 (268 B. C.), that silver coinage was first struck. Pliny says that barbers were first introduced about the same time, and that till then the Romans had gone unshorn. Cicero says the arts which had reached some degree of perfection in Etruria were even allowed to retrograde. He says the Romans had some knowledge of arithmetic and land surveying, but they could not improve their calendar and were not even in condition to erect a common sun-dial. As to the state of commerce and agriculture we are told that in the fourth century of Rome private enterprise was so inadequate to the provisioning of the city that state commissioners were placed in charge of it.

It would seem that Rome was at that period a capital, populous indeed, but without arts or sciences, without industries, and without

cultivation. War was the only trade and plunder the only source of public or private revenue. For the civil purposes of such a people the natural divisions of time were all that were necessary. They marked the periods for toil and repose and that was enough.

These were a ruder people than those of Athens in the time of Solon; but if they had less of culture they had less of tyranny and less of intestine warfare to contend with at home than had the Greeks, and they were always reaching out, widening their domain, absorbing neighboring peoples, and making each in its turn add to the strength and glory of their capital. Whatever the art and science of the subdued nations could contribute to the prosperity of Rome came by the enforced levy of the conqueror.

The time system of early Rome was, like everything else, of the rudest character. Growing out of their military habits and adapted to them, it divided the day and night each into four watches, the periods of which must have been roughly determined by observation of the courses of the sun and stars. In the city, according to Pliny, noon began to be accurately observed some years after the publication of the law of the twelve tables. The *accensus* watched for the moment when, from the Senate House, he first caught sight of the sun between the Rostra and the Græco-Stasis, when he proclaimed publicly the hour of noon. From the same point he watched the declining sun and proclaimed its disappearance.

Authorities differ as to the date of the introduction of the sun-dial into Rome. Pliny attributes it to the consul L. Papirius Cursor, who set it up at the temple of Quirinus. This has been supposed to be a trophy from the Samnite war, but, as the Samnites were a ruder people even than the Romans, that seems scarcely credible. Varro, as reported by Pliny, gives a clearer story, that the first public sun-dial erected in Rome was fixed upon a column near the Rostra in the time of the first Punic war by the Consul Valerius Messala, and adds that it was brought from the capture of Catina. The date given by Varro, 491 A. U. C., corresponds to 262 B. C., and is about 30 years later than that ascribed by Pliny to the dial of Cursor. As a source for this instrument Sicily, with her Greek arts and refinements, is much more probable than the rude Samnite people, and, with real appreciation of Pliny's frankness, we may accept the story he quotes from Varro in preference to his own.

What were the social conditions in Rome at this period, the middle of the third century before our era? It needs scarcely more

than a glance at a chronological table to see that it was a period of swift advance from the primitive rudeness that has been described. In the year 283 B. C. Etruria and her allies, hitherto perpetual foes to Rome, were totally defeated at the Vadimonian Lake, and about 265 B. C. Etruscan independence disappeared forever, simultaneously with the subjugation of all Italy. The whole peninsula her own, Rome reaches out beyond. The Græco-Egyptian monarchy, then at the very height of its power and magnificence under Ptolemy Philadelphus, seeks her alliance. The Greek cities across the Adriatic court her favor. She pushes her conquering arms across into Sicily, which, in 241 B. C., becomes a Roman province, followed a little later by Corsica and Sardinia. No longer *prima inter pares* among the warring tribes and nations of Italy, she has sprung as if at a single bound into her position as one of the great powers of the world.

The absorption of Magna-Græcia and Sicily brought under her dominion for the first time a cultured people and populous cities, filled with and habituated to Grecian art and the appliances of refinement and luxury, and the sun-dial of Catina is but one instance of what was borne away to embellish the Imperial City. Doubtless the fame and wealth of the capital offered strong inducements to the skilled artisans of dismantled Tarentum, while the captives of Agrigentum may, in their turn, have contributed in no small degree to her industrial population.

The colonists planted by thousands far and wide over the conquered territory of Italy formed a sturdy rural population—a strong reliance in peace and war. And the great highways built for the march of the legions, and hitherto scarcely resounding but to their armed tread, now became the arteries of a steady and growing traffic. The needs of a circulating medium in her domestic and foreign trade were ill supplied by the copper coins she had struck hitherto and the products of various foreign mints that had come to her with her other acquisitions, and, in 258 B. C., she began to coin silver of her own. Carthagenian jealousy of her aggressive rivalry led to the necessity of maintaining a fleet, and, after some disasters, to maritime supremacy.

"The ten years preceding the first Punic war," says Dr. Thomas Arnold, "were probably a time of the greatest physical prosperity which the mass of the Roman people had ever seen," and it is in this very decade, with enlarging industries, with a growing commerce, with multiplying complications in public and private busi-

ness, that Rome stepped from the spring time of her history into her vigorous summer, and with this step time-keeping began.

The Catanian sun-dial was no mere gnomon such as had been introduced into Greece three centuries earlier: Greek science and genius had been at work on it, and it was an improved instrument, constructed for a particular latitude, and that 5° south of Rome. But there was no science yet in Rome to detect its imperfections, and, in spite of them, for ninety-nine years it served as the regulator of time for the city. Scarcely credible as it may seem, it was not, therefore, till about a century and a half before the Christian era that Rome possessed her first accurate time-keeper in the form of a sun-dial constructed especially for her own latitude, which was set up at the instance of the Censor Marcius Phillippus. Meanwhile dials of imperfect construction had become common in the city; so common, indeed, that, as new inventions nowadays afford material for the American paragrapher, they became the happy source of quips and epigrams. Thus Plautus, in what I admit is rather a liberal version:

> When I was young, no time-piece Rome supplied,
> But every fellow had his own—inside;
> A trusty horologe, that—rain or shine—
> Ne'er failed to warn him of the hour—to dine.
> *Then* sturdy Romans sauntered through the Forum,
> Fat, hale, content; for trouble ne'er came o'er them.
> But *now* these cursed dials show their faces,
> All over Rome, in streets and public places;
> And men, to know the hour, the cold stone question,
> That has no heart, no stomach, no digestion.
> They watch the creeping shadows—daily thinner—
> Shadows themselves, impatient for their dinner.
> Give me the good old time-piece, if you please,
> Confound the villain that invented these!

As formerly, in Greece, the clepsydra came to supply the deficiencies of the sun-dial, so history repeated itself in Rome. Pliny ascribes its introduction to Scipio Nasica in the year of Rome 595 (158 B.C.). Of the form of this clepsydra we have no knowledge, but it was no longer a mere time-check, such as was used in the Athenian courts, but a true time-keeper, capable of indicating continuously the hours both of day and night. There were many adopted for this purpose, as will presently be shown. In Pompey's third consulship (52 B. C.), he introduced the custom of apportioning the

time of orators in the courts by the clepsydra, after the Greek fashion. The decline of Roman oratory has been attributed to this restriction, which, after all, seems to have left the speaker a fair amount of time. Pliny says: "I spoke for almost five hours, for to the twelve clepsydræ of the largest size which I received, four were added." Some read *twenty* in place of *twelve*, which seems to be the preferable reading, and out of it we get some idea of the time consumed by one discharge of the vessel. If twenty-four clepsydræ is "almost five hours," it appears likely that the discharge was at the rate of five to the hour; and this helps us to better understand Martial's epigram to a tedious lawyer who had been permitted to exhaust the clepsydra seven times. It makes something less than an hour and a half; but the orator's mouth was as dry as his discourse, and he drank copiously, whereupon the witty poet suggests that he can satisfy his thirst and his audience at once by drinking out of the clepsydra.

In Rome at this period the use of the clepsydra, in the form both of a time-check and time-keeper, was quite general—not as the house-clock is common to-day—but generally known and serving to regulate the hours of business and pleasure. Men of means had them in their houses, and slaves were kept whose special duties were to watch them and report the hour. Idlers meeting in the market place or forum accosted each other with "*Hora quota est*," by way of opening conversation, as they now comment on the weather or compare watches. Generals took the water-clock with them to the field and relieved the watch by it during the hours of night. An allusion by Cæsar has been the source of a curious misconception, that he found this instrument in use among the Britons at the time of his invasion. Evidently referring to the phenomenon now so familiar of the Arctic night he says some had reported that at Mona the night at the winter solstice lasted for a month. "Our inquiries," he continues, "did not confirm this, but by careful measurements *ex aqua* we saw that the nights were shorter than on the continent." To draw from this the conclusion that the early Britons had water-clocks is about as if we were to infer from the Signal Service observations at Point Barrow that the Eskimos of that region were found in possession of the thermometer.

Greece, too, had by this time fallen under Roman rule, and the clepsydra as a time-keeper was well-known in Athens. The most eminent instance of it, probably, for all time, was in the Tower of the

Winds, which, fifty years before our era, was erected in the market place in that city. A running stream kept at a constant level the water in an upper vessel, the discharge from which raised a float in a lower one, like that in the Chinese water-clock before described. This was the public time-piece of Athens, and its indications could always be compared with those of the sun-dials on the frieze of the octagonal building by which it was enclosed. At the top of the roof was a weather-vane in the form of a Triton, who pointed with his trident towards the prevailing wind. This institution served for Athens the combined purpose of a Naval Observatory and a Weather Bureau.

With time-keeping so generally observed, and with a fair degree of accuracy secured by means of mechanical contrivances, this history closes, but in reciting it I have omitted or only incidentally touched upon the growth of the idea of dividing the day into hours and the mechanical elaboration of what, in its perfected form, is properly termed the water-clock. These elements, in the complete history, are too important to be omitted.

Since we are only concerning ourselves with time-keeping in common life, we need not go back to Egypt or Babylon, where there is no evidence that it was known except to the initiated few. Whatever ideas are conveyed to us by the twelve divisions of the day known to the Babylonians, or by the graduated dial set up by the Hebrew king in his palace, it is evident that if the Greek philosophers derived from their Eastern contemporaries any notions of common or domestic time-keeping, these failed to take root in their soil until Greece, by her own progress, had prepared it to receive them.

The divisions of the day known to Homer were three: ἠώς, for the period from sunrise till noon; μέσον ἦμαρ, for mid-day; and δείλη, for afternoon till sunset. These divisions were employed in Greece to the latest period and long after others more exact were in use. Even with our nice observance of time we have similar general expressions for parts of the day, such as morning, mid-day, afternoon, and many others often having only local use.

If the Babylonian "twelve parts" of the day were made known to the Greeks, as Herodotus tells us, it was a knowledge for which they had no use at that period. With the introduction of the gnomon they began to observe time more closely, but they had no names for its arbitrary divisions.

When the shadow was six feet long it was time to bathe; when twice that length it was time to sup. It is not even certain, to my mind, that they clearly appreciated the varying length of the day. There is no possibility of setting a summer and winter day side by side and comparing them, and the difference between them can only be determined by some means of measuring time quite distinct from observation of the sun or shadows. The great difference between the days of winter and summer in our latitude, which is nearly that of Athens, seems to us to be plainly discernable; but if we could divest ourselves of our acquired knowledge and of our means for keeping time, and put ourselves in the place of the Greek of 600 B. C., we should probably fail to observe the fact except very dimly.

Accurate division begins with the observation of noon, and we have seen pretty clearly when this began in Greece. The next step in subdivision consists in dividing the day into quarters by dividing equally the periods before and after noon. This division was at least known to the Greeks, but I see no evidence that it was in common use; nor, in fact, does it appear that they, in daily life, made use of close subdivisions until Roman influences prevailed and the Roman divisions of the day were adopted.

In Rome the division of both the day and night into four watches resulted naturally from the military character of her people and remained in use down to the latest period. These divisions of the day corresponded with what were afterwards the third, sixth, and ninth hours, and it was customary for one of the subordinate officers of the praetor to proclaim them. They had also a three-part division corresponding to that of the Greeks.

Artificial means of measuring time came to the Romans so much later than to the Greeks that great improvements had been wrought in them. Science had gone so far in Egypt and Sicily that sun-dials were constructed for particular latitudes; but it is not clear that, as at first introduced, they were graduated. The same subdivision of the day into four watches that has just been noticed might obviously give the first suggestion of such graduation by bisecting the angle between the noon-mark and those of sunrise and sunset. As a closer subdivision was required the Romans appear to have taken one already known in Egypt and better adapted to the latitude of Thebes and Memphis than to that of Italy. This was the division of the day and night into twelfths (which varied in their length as

the seasons changed) and is commonly known as the Roman system. Before intimate relations began between Rome and Egypt, Greece had already been annexed and the same system was introduced there, as also in Palestine and wherever the Roman eagles penetrated. This division adapted itself perfectly to the older one already in use in Rome and its adoption was natural. The only change in the sun-dial that it involved was a further subdivision of the spacing. Being an improvement that cost nothing and could be adopted without any radical changes in the habits of daily life it was one to commend itself to a people who were slow to change; and when, a few years later, in the middle of the second century B. C., Hipparchus proposed the division into equinoctial hours, the same as used now, the proposition met no welcome. This accurate and convenient system did not adapt itself to the established notions of the times, and the Roman hours secured a firmer and firmer grip, resulting, as I am inclined to believe, in one of the most remarkable instances of retardation of invention that history records. It was not until Europe had emancipated herself from slavery to this most awkward of time systems that modern time-keeping became possible. For many centuries invention was, as it were, thrown off the scent by the necessity of converting the regular and uniform motions which could be given to mechanism into means for displaying the ever-varying hours of the Roman system.

The word "hora," proposed by Hipparchus to express these divisions of the day, was adopted in its new sense by Greeks and Romans simultaneously and has ever since held its place in all the languages of Europe. In fact it was used in two senses: in its significance of the varying Roman hour it could not be employed to define exact intervals of time; when employed for that purpose it expressed exactly what we express by it now—the twenty-fourth part of a civil day. The passage in Pliny I have quoted is not intelligible unless the word "hour" is employed in this sense.

Enough was said in the early part of this paper to show the line in which the clepsydra developed, the water clock at Canton and that in the Tower of the Winds at Athens being examples of it in a fairly perfected state as a time-keeper. Invention had succeeded in giving to the rising pointer a regular motion and adapting it well to its purpose. Other advances were made in it, and of these it remains to speak. Improvement, handicapped by the clumsy Roman hours, found in this fact a stimulus to ingenuity. To adapt it to indicate

these hours one rude scheme was to reduce the capacity of the vessel from which the water flowed by coating it with wax in the winter time. The orifice remaining unchanged it emptied more quickly. The wax was gradually removed as the days lengthened. Of course, the same instrument could not serve for both day and night. Less clumsy means for regulating the flow, as by adjusting the size of the orifice, were afterwards invented. One of these involved the passage of the water through a hollow cone or funnel, in which was an interior cone capable of adjustment for each day in the year; another, invented by Ctesibius, left the water flow, and consequently the rise and fall of the float, constant, but included an automatic device by which the graduated scale over which the marker traveled was changed daily.

This difficulty in adapting the clepsydra to keep Roman time is precisely the same that the early Dutch navigators met with on their introduction of the clock into Japan, where the division of the day is into ten hours of varying length. The plan they adopted is a clumsy one, but of the same character as that of Ctesibius, since they did not attempt to alter the rate of the clock, but attached movable indications to the dial so that they might be changed with the season. One of these clocks is in the possession of the Bureau of Education, a gift from the Japanese Government after the Centennial Exposition of 1876.

But improvements in the clepsydra such as have been described, notwithstanding the ingenuity and mechanical skill they displayed, are of little consequence to us, since they were not towards the accomplishment of the final result but away from it. The actual steps towards the modern clock appear to be these: First, the employment of the ordinary rack and pinion device. If we are right in attributing the invention of gear-wheels to Archimedes, this application could not have been made earlier than the middle of the third century B. C. (287 to 212). It is attributed to Ctesibius, who, for many reasons, as I have said already, is placed a century later than this. A series of teeth, commonly called a rack, was attached to the side of the rod, which was supported by the float, and had heretofore served only as an index. Fixed on a horizontal shaft above the vessel was a small toothed wheel, with which the toothed rack engaged, and which was, therefore, caused to turn by the rise of the float. On this shaft was a pointer attached like the hour-hand of a clock and traveling over a similar dial. To make

this hand complete a circuit in 12 or 24 hours is, obviously, only a question of the proportion of parts. The next step forward dispensed with the rack and pinion and really was in the line of greater simplicity. In place of the toothed wheel a grooved pully was used, over which passed a cord from the float, being kept tight by a weight at the other end. The hand remained on the wheel shaft as before, and with the gradual rise of the float, traversed the dial.

We have reached the point where we may say "*presto, change,*" and behold, a clock springs into view, for it is instantly apparent that with this structure it is no longer the water that advances the hand; water is not the motor now. The weight is the motor, and its fall is retarded by the float, which only permits its descent as fast as the rise of water in the vessel permits its own rise. We have an actual weight clock, with what we must be content to regard as a water escapement; it is far enough from our perfected timepiece, but in respect to its essential elements it differs in but one, and henceforth the problem of the clock is only that of escapements. But we need not expect it to be solved at once. It will be centuries before the actual problem will be recognized, so great is the obscurity with which the Roman time system has beclouded the subject.

There is a long and mournful perspective before us. The golden age of Roman literature is here, but she has yet to see the greatest extent of her empire and the summit of her own magnificence. A long line of Cæsars will come, base and noble alternating. Her decline will follow her glory; her palaces are to be plundered by barbarous northern invaders; her empire is to be shattered; out of her vast domain new peoples and nations and empires scarcely less mighty than her own are to spring, while she herself sinks to the paltry dimensions of a village. Her polished speech shall die from men's lips, but the rude dialects of her provinces, mingling with the uncouth tongues of illiterate Franks and Goths, shall develop into new languages, in time to become as perfect vehicles of thought as their original. New forms of government and of social order shall spring from her laws and institutions and philosophies; and from the hills of credulous and despised Judea is to burst a new religion, before whose bright beams the perpetual fires of Vesta shall pale and the whole train of Olympian gods vanish like the mist. But amongst these unconceived changes, and through the storms that shall sweep away and the cataclysms that shall engulf all the objects

of her pride and glory and reverence, there shall still endure what she cared least for—constant in all their inconstancy—the Roman hours.

The problem of improving the time-keeper is one with which cloistered scholars and mechanicians will not cease to contend, but the barrier that Rome has set up will continue to baffle their ingenuity; and when thirteen centuries shall have passed since Hipparchus in vain urged the advantages of the equinoctial system and Ctesibius strove to solve the riddle of Roman time by some practical mechanism, we shall still find *Bernardo Monachus* recording how the monks of Cluny perplexed their pious souls with the old, old question, and how the good sacristan must needs go out into the night to learn—from the stars—if it were time to call the brethren to prayer.

DISCUSSION.

The above paper, read before the Anthropological Society of Washington April 5, 1887, was discussed by Messrs. PIERCE, MASON, THOMPSON, BLISS, BLODGETT, MALLERY, and BABCOCK.

Prof. MASON referred to a simple time-check used by a Chinese physician. It was a joss-stick broken so as to have several angles. The doctor set fire to one end and instructed his patient to take his first dose when the fire reached the first angle, another when it reached the second, and so on.

Mr. A. H. THOMPSON spoke of a rude timepiece which he had seen among the Zuñis. It was a plate set in the wall of a hut opposite a hole in the other wall. When the sunlight coming through the hole fell upon the plate the Zuñis knew that it was time to plant corn.

Mr. DORSEY referred to the divisions of time from sunrise to sunrise observed among certain Indians in Oregon. These Indians have about forty names for different parts of the day and night.

Mr. BLODGETT, referring to the speaker's doubt whether the Romans appreciated the difference in the length of the days at different seasons of the year, remarked that it is an old saying that time is measured by events. While small variations in the length of the day might not be detected, it is hardly conceivable that any people who had sufficient advancement to have occasion to pass over the same areas in different seasons should not observe that

such an act as going to a distance for fuel or for water could not be repeated so many times in the short days as in the long ones. Any action whose rate became somewhat habitual, as the movement of an army, the carriage of burdens, or the performance of agricultural tasks, would form a basis of comparison that would be forced on the attention of the actors. When beasts of burden were used their movements would emphasize the difference between the long and the short days. Even in our day time in Oriental countries is measured by the gait of the camel.

Col. MALLERY remarked that the marching of armies and the hauling of produce do not ordinarily take place in the winter season.

Mr. BABCOCK said that hunting was pursued at all seasons. The Indians who lived here used to go over to the Patuxent river to hunt and fish at all times of the year. It is hardly conceivable that they did not observe how much longer they could travel before dark in summer than in winter.

CURIOUS VARIETY OF BLOOD REVENGE.—British Consul Plumacher reports the following type of vendetta among the Goajira Indians living on the extreme northwestern part of Venezuela. By the payment of the compensation of "tears and blood" any injury may be condoned—not the aggrieved one, but his relatives, especially those on the mother's side, demanding the blood money. If an Indian accidentally injure himself, his mother's family immediately demand of him the "payment of blood," on the theory that as his blood is also their own he has no right to shed it without compensation. The relatives of the father claim the payment of "tears," which is not so large. Even the friends who witnessed the accident are entitled to pay for their grief. The amount of payment depends on the injury. A trifling cut of the finger calls for a little corn or something of equal value; a more serious grief is assuaged with a sheep or a cow. If the injured party is too poor he must beg from hut to hut, and no one will refuse to contribute. If an Indian borrows a horse from a friend and is thrown or injured the owner must pay, since the accident would not have happened if he had not lent the animal. If a man is injured by his own animal he himself must compensate his relatives. The seller of an article is responsible for the results of its misuse. If a person should be wounded or lose his life in attempting to kill another the latter must pay blood and tear money in the same manner as if he had been the aggressor. Should a child die in the absence of one of its parents the absent one may demand from the other payment for the tears supposed to be shed over the occurrence.—Jour. Soc. Arts, xxxv, 928.

ANTHROPOLOGICAL NOTES ON THE HUMAN HAND.

BY FRANK BAKER, M. D.,
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A short time ago, while in the room where the corpse of a lovely young girl lay awaiting burial, I noticed that many of the passing visitors lifted the hand of the dead and applied it to some part of their own bodies—head, arm, face, breast. I was not sure what was meant by this and took occasion afterwards to ask one of those whom I had observed making this application, and was told that it was intended as a cure for various disorders. It appeared that this young girl had lived a notably pure and holy life, and that the touch of such a person was believed to be especially curative against tumors, warts, headache, and minor affections. My informant was, I was assured, immediately cured of a severe headache.

This led me to further inquiry and I found the custom to be widely spread. In two notable and quite recent instances, those of a Carmelite nun dying in Baltimore and a well-known Catholic priest who died in this city, many applications of the dead hand were made with reputed success. In both of these cases throngs of people pressed to obtain the coveted touch. Nor is the belief confined to those of the Roman Catholic faith; a female homœopathic physician, formerly an army nurse, told me that once during her hospital service two soldier patients, suffering from malarial fever of a persistent type, came to her and asked permission to prepare for burial the next patient who might die. Upon inquiry it was found that they firmly believed that they could "break the chills" by an application of the dead hand, and it was for that reason that they sought this task. They were allowed to make the trial and were thereby speedily cured! Neither of these patients was a Catholic. In another case a white swelling was cured by a murderer's hand surreptitiously obtained. The moral quality of the individual to whom the member belonged seems to be a matter of importance. I was told, by a person who had knowledge of the facts, that, in the burial place for the paupers of this city, graves are not infrequently violated for the purpose of obtaining a hand or an arm, the cadaver being otherwise uninjured.

In Staffordshire and in Galloway it is held that a dead hand rubbed on warts causes them to disappear.* In Berwickshire, a short time ago, applications of the dead hand were made to remove wens, and in Northamptonshire crowds of sufferers used to congregate about the gallows-tree on days of public executions to receive "the dead stroke," nurses even bringing children for the purpose. The swelling is believed to decrease as the body of the criminal moulders away.† Eye-witnesses living in 1868 in West Sussex, England, described the revolting ceremony of stroking at the gibbet, and the touch of the dead hand (not criminal) was still used for goitre and other affections, the stroke being applied nine times from east to west and nine times from west to east.‡ Similar occurrences are related at the execution of Dr. Dodd, in 1777,§ and at the execution of the murderer Crowley, at Warwick, in the year 1845.‖

It is needless to say that no record has been kept of the failures of this strange remedy, and the curious critic might imitate the Roman who, on seeing the tablets hung in the temple of Neptune by those who had been delivered by calling on the god, asked to see the tablets of those who had been drowned after a similar appeal.

The reason for these curious superstitions is obvious. The hand is so intimately connected with the brain as the executor of its behests that the savage mind naturally ascribes to it a separate and distinct force independent of the rest of the body—makes it, in fact, a fetish. Savage tribes wear necklaces made from the phalanges of those slain in battle, as witness the Cheyenne necklace of this character recently deposited in the National Museum. A similar custom prevailed among the Greeks, who wore the fingers and toes of a murdered relative under the armpits to avert the vengeance of the Furies.¶

* Dyer (T. E.). English Folk Lore. London, 1884. Mactaggart's Gallividean Encycl., p. 462.

† Hardy (James). Warts and Wen Cures, Folk Lore Record, i, 1878.

‡ Latham (Charlotte). Some West Sussex Superstitions lingering in 1868. Folk Lore Record, i, 1878.

§ Fraser's Mag., xxxvi, 1847, p. 293.

‖ Brand (John). Popular Antiquities of Great Britain. London, 1877.

¶ Grant (James). The Collected Mysteries of All Nations. Leith, London, and Edinburgh. n. d.

One of the most famous and authentic relics of the middle ages was the hand of St. John the Baptist. It appears that after his execution by Herod he was buried at Sebasta. St. Luke and other disciples wished to remove the entire body and opened the grave by night for the purpose, but, fearing discovery, merely took the right hand, with which our Lord had been baptized. St. Luke carried the hand to Antioch. Constantine Porphyrogenitus bribed a deacon of the Antioch church to steal it, and it was brought to Constantinople and placed in the church of St. John. It remained there until the city was captured by the Turks, when, owing to the value of its casket, it was placed in the treasury of the Sultan. It was presented by Bajazet to D'Aubusson, the grand master of the Knights of St. John, and was kept by them as the most precious of their relics, first at Rhodes and afterwards at Malta.*

The independent power of the hand is distinctly held in many passages of ancient poetry and philosophy, which, though figurative, bear evidence of prevailing beliefs. "If thy right hand offend thee cut it off" seems to imply a distinct feeling of vengeance against a guilty member, like that which animated Cranmer at the stake. The Greeks cut from the body of a suicide the hand which had committed the deed and buried it in a separate place. As a symbol of force and power the hand has often been used, as witness the hand upon the sceptre and the gauntlet of heraldic blazonry.

The belief that the living hand is a natural collector and conveyer of force has been current in all ages and is by no means extinct. Most of us have had personal experience of the wide extent of this notion. Who has not seen those suffering from nervous headache decidedly benefited by the touch of the hand of some cool and composed person? Often, perhaps always, the calming of the nervous irritation is brought about by suggestion and the general composure and quiet of the operator. Many so-called healing mediums use the "laying on of hands" as a means of conveying the "spiritual influence," and one has only to dip very slightly into the mass of literature on this subject to become convinced that there is a vast quantity of evidence extant showing that the patients have believed themselves cured of a great variety of disorders. In some of these cases hypnotism is no

* Porter (Whitworth). A History of the Knights of Malta. London, 1883, pp. 296, 297.

doubt a factor and produces certain therapeutic results. Most village communities in retired localities have one or more persons who are reported to have the power to heal by application of the hand, often accompanied by some spoken conjuration or charm.

The royal touch for king's evil is one of this class of survivals. Boswell gives an account of the touching of Dr. Johnson by Queen Anne, which occurred as late as 1712. Either the prerogative in this case was wanting or the elements of faith were lacking, for the touch produced no result. Charles II used to give regular public notice of receptions in which he would heal by touch. It appears from actual register kept at the time that from 1660 to 1682 above 92,000 people were touched by "His Sacred Majesty,"* as many as 8,477 during the last year. The traditional power also existed in certain noble families of pure blood.

From the use of the hand as an instrument for healing to that of its use as a charm is not far. Magic and the healing art have always been more or less allied in the popular mind. Disease is yet regarded as an evil spirit that must be driven out, and the votaries of the mind and faith cures still exorcise the demon with appropriate ceremonies. Detached portions of the dead hand are quite commonly used among the illiterate classes for some supposed lucky influence that they bring. I have known them to be taken from dissecting rooms for that purpose. Old negroes are very apt to have some superstition of this sort. This is a form of the same belief that makes it lucky to carry the fore paw of an animal. It will be remembered that at the beginning of his administration President Cleveland had several fetishes of this kind sent him, notably a rabbit's paw from Florida and a bear's paw from Canada. At least one United States Senator always carries a similar talisman about his person. Among the poor whites of North Carolina, a mole's paw cut off while the animal is still living is believed to be especially efficacious.

This superstition, too, is very old. Among the Romans, dead bodies were often violated by cutting off fingers or toes, or even whole limbs, for magical purposes, and these ghastly fragments formed a part of the regular paraphernalia of a witch's kitchen

*The Gentleman's Magazine, 1811, Part II, p. 125, cites this statement from "Charisma Basilicon; or the Royal Gift of Healing Strumæs or King's Evil," by John Browne, Chirurgeon in ordinary to his Majesty, 1684.

during the middle ages. Shakespeare introduces "finger of birth-strangled babe" as an ingredient of the witch broth in Macbeth. Accounts of the use of parts of the hand in incantations were often elicited upon witch trials. In order to shipwreck King James on his voyage to Denmark a meeting of witches was held at Preston-pans, and with appropriate ceremonies four joints of dead men's fingers were tied to a cat's feet. The animal was then thrown into the water off Leith pier and a dreadful storm was thus raised.*

During the winter of 1885–'6 an entire hand was stolen from the dissecting room of the Georgetown Medical College in this city. The janitor of the college was a white man of decidedly Bohemian habits and at the time was living with an illiterate woman of the Southern poorer class. The woman had conceived a passion for a dead hand equal to that which Iago had for Desdemona's handkerchief, and many a time had begged of him to steal it. This he did. When asked what she intended to do with it he stated that she believed that she could use it "for luck" and to find money and treasure with.

This was probably a survival of the hideous superstition known in the middle ages as the "hand of glory." The most authentic account of this is contained in the "Secrets du Petit Albert," a book of magical recipes, which was translated from Latin into French during the last century.† I have not seen the original Latin; the translation is as follows:

De la main de gloire dont se servent les scélérats voleurs, pour entrer dans les maisons de nuit sans empêchement.

J'avoue que je n'ai jamais éprouvé le secret de la main de gloire; mais j'ai assisté trois fois au jugement définitif de certains scélérats qui confessèrent, à la torture, s'etait servi de la main de gloire dans les vols qu'ils avoient faits; & comme dans l'interrogatoire, on leur demanda ce que c'étoit, & comment ils l'avoient eue, & quel en étoit l'usage, ils répondirent: premièrement, que l'usage de la main de gloire étoit de stupéfier & rendre immobiles ceux à qui on la présentoit, en sorte qu'ils ne pouvoient non plus branler que s'ils etoient morts; secondement, que c'etoit la main d'un pendu;

* Scott (W.). Letters on Demonology and Witchcraft, Letter IX.

† Secrets merveilleux de la magie naturelle et cabalistique du petit Albert, traduits exactement sur l'original latin, intitulé: Alberti Parvi Lucii libellus de mirabilibus naturæ acarnis. A Lyon, MDCCLXXVI.

troisièmement, qu'il falloit la préparer en la manière suivante. On prend la main droite ou la gauche d'un pendu exposé sur les grands chemins, on l'enveloppe dans un morceau de drap mortuaire, dans lequel on la presse bien pour lui faire rendre le peu de sang qui pourroit être resté; puis on la met dans un vase de terre avec du zimat, du salpêtre, du sel & du poivre long, le tout bien pulvérisé, on la laisse durant 15 jours dans ce pot; puis l'ayant tirée, on l'expose au grand soleil de la canicule, jusqu'à ce qu'elle soit devenue bien sèche; & si le soleil ne suffit pas, on la met dans un four qui soit chauffé avec de la fougère & de la verveine; puis l'on compose une espèce de chandelle avec de la graisse de pendu, de la cire vierge & du sisame de Laponie, & l'on se sert de cette main de gloire comme d'un chandelier pour y tenir cette chandelle allumée; & dans tous les lieux on l'on va avec ce funeste instrument, ceux qui y sont demeurent immobiles; & sur ce qu'on leur demanda, s'il n'y avoit point de remède pour se garantir de ce prestige, ils dirent que la main de gloire devenoit sans effet, & que les voleurs ne pourroient s'en servir si on frottoit le seuil de la porte de la maison, ou les autres endroits par où ils peuvent entrer, avec un onguent composé de fiel de chat noir, de graisse de poule blanche & du sang de chouette & qu'il falloit que cette confection fût faite dans le temps de la canicule.

Of course, such a blood-curdling superstition as this is often pressed into service by novelists and poets.

Harrison Ainsworth, in Rookwood, puts the following cheerful song into the mouth of a sexton:

"From the corse that hangs on the roadside tree,
(A murderer's corse it needs must be,)
Sever the right hand carefully—
Sever the hand that the deed hath done
Ere the flesh that clings to the bones be gone;
In its dry veins must blood be none.
Those ghastly fingers, white and cold,
Within a winding-sheet enfold;
Count the mystic count of seven,
Name the Governors of Heaven,*
Then in earthen vessel place them;
Bleach them in the noonday's sun
Till the marrow melt and run,
Till the flesh is pale and wan
As a moon-ensilvered cloud,
As an unpolluted shroud.
Next within their chill embrace
The dead man's awful candle place;

* The seven planets, so called by Hermes Trismegistus.

Of murderer's fat must that candle be,
(You may scoop it beneath the wayside tree,)
Of wax and of Lapland sisame.
Its wick must be twisted of hair of the dead,
By the crow and her brood in the wild waste shed.
Wherever that terrible light shall burn,
Vainly the sleeper may toss and turn;
His leaden lids shall ne'er unclose
So long as that magical taper glows.
Life and treasure shall he command
Who knoweth the charm of the Glorious Hand!
But of black cat's gall let him aye have care,
And of screech owl's venomous blood beware!"

This is a tolerably close version of Petit Albert.

Scott (Antiquary, chap. xvii), Barham (Ingoldsby Legends), and Southey (Thalaba, Book V) all give variants of the same theme.

There are several authentic instances of the use of the hand of glory by housebreakers. In 1831 thieves entered a house in Loughcrew, Ireland, armed with such a contrivance, evidently believing that the inmates would not awaken. They were mistaken in this, however, as the family were alarmed, and the robbers fled, leaving their horrible charm behind them.

Henderson* relates the following, told in 1861 by an old woman whose mother was the principal actor. The events related took place between the years 1790 and 1800 at the old Spital Inn, the place where the mail coach changed horses in High Spital on Bowes Moor. A servant girl had orders to be up to prepare an early breakfast for a female traveler. She lay down to sleep on the long settle before the fire, but, before closing her eyes, espied a man's trousers beneath the gown of the traveler, who sat on the opposite side of the hearth. She, however, feigned sleep, when the traveler arose, pulled from his pocket a dead man's hand, fitted the candle to it, lighted the same, and passed hand and candle several times over the servant girl's face, saying as he did so, "Let those who are asleep be asleep and let those who are awake be awake." This done he went out of the door and began to whistle for his confederates. The girl shut and locked the door and ran upstairs to wake the family, but calling, shouting, shaking were

* Henderson (William). Folk Lore of the Northern Countries. London, 1879.

alike in vain. She heard the traveler and his comrades outside the house, ran down again and put out the candle with skimmed milk, after which the family were easily awakened. Upon being asked what they wanted, the ruffians said that if the dead man's hand were but given them they would go away. This being refused and a shot fired at them, they disappeared.

The Rev. S. Baring Gould* tells a story similar in many details. In this, however, the magicians—there were two—lighted the *fingers* of the hand itself after anointing them. The thumb they could not light, as one of the family was not asleep. Attempts to awaken the master of the house failed until the servant blew out the burning hand.

A third story told in Northumberland† combines the differences of the other two. A watchful servant saw the suspicious-looking traveler anoint and light the dead fingers, the thumb remaining unlighted. Failing to waken her master and the household, she tried to extinguish the burning hand, first by blowing upon it, then by throwing upon it the dregs of a beer jug, but it burned brightly till she emptied the contents of a milk jug over it, when the flames died at once, the family awakened, and the thieving traveler was seized and afterwards hanged.

A variation of this superstition is found in Belgium. In West Flanders a thief was taken in recent times on whom was found the foot of a man who had been hanged, which he used for the purpose of putting people to sleep, and Henderson tells of a sorceress of the village of Alveringen who had a thief's finger over which nine masses had been said, she laying it upon the altar as a relic. With it she put people to sleep while she stole their possessions.

In 1834 an old soldier, Frederick Berger, was arrested for the murder of a herdsman, Meier, in Pomerania. The corpse of the murdered man had been mutilated, and it was shown on the trial that Berger had cut out a piece to make a "thief's candle." He protested his innocence of the murder, but was, nevertheless, executed. In 1844 a sailor named Memel confessed that he was the murderer. Berger had merely found the corpse when dead or nearly so.‡

* Gould (S. Baring). Curious Myths of the Middle Ages, 2d series. Schamir.

† Henderson, *op. cit.*

‡ Gould (S. Baring). A Strange Crime. Gentleman's Magazine, April, 1887.

Gould also cites the case of a Lanzknecht burnt alive in Lithuania April 13, 1619, for a similar crime; he confessed he had also used infants' fingers. Further, two murderers executed in 1602 at Budissin, one man sentenced in 1638 at Ober-Haynewald to imprisonment for cutting off the thumb of a man hanging in chains, one broken on the wheel at Bamberg in 1577, one at Nuremberg in 1601.

Cox, in his Aryan mythology, considers the hand of glory as one of the lightning myths, allied to the magical taper of the Moor,* which opened, with a thundering noise, bolts, bars, and even adamantine rocks concealing secret treasures. Gould agrees with this view, classing it with other mythical objects which could break rocks and bolts, viz., the Schamir of Solomon (Persian), Springwort (Scandinavian), Luckflower (German), Sesame (Arabian), Saxifrage (classic antiquity).† It will be noted that most of these are plants, and that "Lapland sisame" is one of the ingredients of the dead man's candle.

A further examination of this subject has convinced me that this is not wholly correct. It is more probable that the myth arose during the middle ages among thieves and illiterate persons in France by a misunderstanding of words; *mandragore*, the French term for the mandragora or mandrake,‡ being mistaken for *main de gloire*. The term *mandegloire* is given by Dujardin-Beaumetz in his *Dictionnaire de Thérapeutique*, now publishing in parts, as a popular synonym for mandragore. In southern France the main de gloire is known as the *man de gorre*, so we see the error in various stages of its growth.§

The mandragora is solanaceous, allied to belladonna, and possesses similar properties. Its root is spindle-shaped, often forked, and it is said to grow in glooomy forests and about the mouths of caves. spots of evil repute to the primitive mind.|| It was used as

* See The Moor's Legacy, in Irving's Tales of the Alhambra.

† Gould. Curious Myths, &c., *loc. cit.*

‡ This is the *Mandragora officinarum* of Linnæus, now divided into two species, the *M. vernalis* of Bertoloni, found in southern and central Spain, northern Italy, Dalmatia, Thessaly, Syria, and Crete, and the *M. autumnalis* of Sprengel, found in southern Spain, Calabria, Sicily, and Greece.

§ Larousse (Pierre). Dictionnaire Universel de la XIX^e^ Siècle.

|| Vossius, cited in Richardson's Dictionary, suggests an etymology for mandragora [*μανδραγόρας*], deriving it from *μάνδρα*, an inclosed space, and *ἀγορεύω*, to tell.

a powerful narcotic by physicians of the 15th and 16th centuries, and appears besides to be analgesic, being used to deaden pain during surgical operations.* Richardson† has lately made a careful examination of its physiological action and confirms this. It is peculiarly benumbing, and was probably the drug that Shakespeare makes Friar Lawrence give Juliet. Othello says:

> "Not poppy, nor mandragora,
> Nor all the drowsy syrups of the world,
> Shall ever medicine thee to that sweet sleep
> That thou ow'dst yesterday."

And Cleopatra:

> "Give me to drink mandragora,
> That I might sleep out this great gap of time—
> My Antony is away."

Many superstitions were connected with the plant. The frequent forked appearance of the root had a distant resemblance to the belly and lower limbs of man. According to the doctrine of signatures then in vogue, this made the plant of especial value for producing fertility in women‡ and procuring easy delivery in childbirth; this was soon extended to giving it talismanic qualities, and the possession of one of these roots was believed to bring increase of possessions, good luck, the finding of hidden treasure, and the like. Joan of Arc was said to owe her great success against the English to a mandrake root. The Arabs call it the devil's candle, believing that its leaves shine at night.§ This belief was also current in the tenth and eleventh centuries, as shown by Anglo-Saxon manuscripts of that period.‖

The author of *Les Secrets du Petit Albert* figures one of these roots¶ that he saw in the possession of a peasant, who buried it in

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* Et quando fiunt necesse incidere vel cauterizare aliquod membrum volumus quod non sentiatur detur ei in potu prius.—From the Tractatus de Virtutibus Herbarum of Arnoldus de Villa Nova, 1499, § xcv.

† British and Foreign Medico-Chir. Review, January, 1874.

‡ See La Fontaine's story "La Mandragore."

§ Moore has adopted this in his description of the eyes of the Gheber in Lalla Rookh:

> "In whose red beam, the Moslem tells,
> Such rank and deadly luster dwells
> As in those hellish fires that light
> The mandrake's charnel leaves at night."

‖ Folkard (Richard), Jr. Plant Lore, Legends, and Lyrics.

¶ *Op. cit.*, p. 159.

a grave at a propitious conjunction of the planets on a Monday in spring. For a month he sprinkled it each morning before sunrise with milk in which three field-mice had been drowned. It was then more human-like than ever. He proceeded to place it in an oven with vervain and wrap it in a fragment of a shroud. He was successful both in games and at work and became quite rich through its means.

The demon-like character became even more elaborated. Either from the gloomy nature of its habitat, or from the falsehoods of interested quacks, it was believed to be very difficult to procure. It was said to grow very sparingly except under a gallows-tree, some alleging that it thrived only when fed by the foul drippings of the putrefying corpse, others that it was actually formed from the semen of the criminal. When it was pulled up a loud shriek was heard which killed or drove mad those who heard it.* It could be used to stupefy victims while thieves might rob at their will.

The similarity of this myth to that of the hand of glory will be noted; it seems clear that there has been a transference, the other details being a natural product of the terror-stricken imagination of a superstitious and credulous age.†

While making inquiries concerning current superstitions I have been surprised to find that, even among cultivated and intelligent people, there is a belief that the minutiæ of character may be inferred from an inspection of the hand. As I have been gravely assured, after an examination of my own fingers, that I possess some tendencies toward philosophy, I may perhaps be allowed to make a few remarks upon this gipsy-like child that claims a place in the family of sciences.

It is probably not so much a survival of the old notions of palmistry as a revival brought about by the efforts of a number of writers of some ability who have constructed a pseudo-science, resembling phrenology and physiognomy, based upon the forms and characteristics of the hand. The ablest of these are Captain d'Arpentigny,‡ Prof. Carus,§ and Desbarrolles.‖

* Romeo and Juliet, act v, scene 3.

† See also in support of this view Littré's Dictionary, Article—Main.

‡ D'Arpentigny (C. S.). La chirognomie, ou l'art de reconnaître les tendances de l'intelligence d'après les formes de la main. Paris, 1843.

§ Carus (C. G.). Ueber Grund und Bedeutung der verschiedenen Formen der Hand in verschiedenen Personen. Stuttgart, 1846.

‖ Desbarrolles (Ad.). Les mystères de la main révélés et expliqués. Paris, 1859.

M. d'Arpentigny was an officer of the French army. Fond of social pleasures, he was, as a young man, in the habit of frequenting the receptions given by a rich country gentleman who lived near him and who had a leaning towards the more practical sciences, engineering, architecture, and construction. His wife was a lady of literary tastes and cultivated the society of artists, musicians, and *littérateurs*. They held receptions upon different days for their own special sets of acquaintances, but M. d'Arpentigny was at home in both circles. He came to notice that the hands of the mathematicians and engineers were markedly different from those of the frequenters of the parlors of madame. Upon this he instituted an investigation which led him to formulate a "science of the hand."*

The ground taken by the advocates of the system is reasonable enough at bottom. It is simply the Lamarckian theory of use and adaptation expressed by Gœthe long ago:

> "Also bestimmt die Gestalt die Lebensweise des Thieres,
> Und die Weise zu leben sie wirkt auf alle Gestalten
> Mächtig zurück."
>
> —*Die Metamorphose der Thiere, 1819.*

The mind and the body act and react upon each other. Thus far no one can dispute the philosophy of these speculators, and did they attempt to take into account *all* expressions of bodily form as significant of mental characteristics their effort would be a worthy one; but they go on to single out the hand as the especial and peculiarly endowed servant of the brain; they bring in under the cloak of science the same superstition which was shown the door when it assumed the dress of magic, and attempt to connect a multitude of minute details of mental character and aptitude with variations of anatomical structure and configuration of the fingers and palm. They hold that man is a microcosm or epitome of the universe and that the hand in a similar way must be an epitome of the man.

That the hand is shaped by the uses to which it is put is unquestionable. In a general way much may be learned of the occupations, mechanical aptitudes, and tendencies of a man by an inspection of his hand.† We may, perhaps, go somewhat further than

* This is strikingly like the history of the origin of phrenology as related by Gall.

† See, for example, the valuable work of Vernois (M.), De la main des ouvriers et artisans, au point de vue de l'hygiène et de la médecine légale. Paris, 1862.

this and say that with the inherited cast of mind which imparts a tendency towards definite occupations there may also be transmitted a definite form of hand, and that types may be thus produced; but the same may be said of every other part of the body.

The cheirognomists soon leave the solid ground of induction for the vagaries of irresponsible speculation or even charlatanry. What can we think of an author who tells us, as M. d'Arpentigny does, that "callosity in a hand seems always to cast a shadow upon the mind," and who explains that a taste for horticulture increases with advancing age because "it is then our hands, stiffened and bony and bereft of their delicate tactile organization, offer a faithful reflex of our impoverished imaginations"?

Zadig was able to state of a camel he had not seen that he was blind of one eye and had lost one of his front teeth, judging from the appearances left where he had been grazing. He did not, however, venture to declare the color of the animal, to say whether or not he was gentle, obedient to his master, or fond of the opposite sex. The hierophants of cheirognomy seem, like the physiognomists and phrenologists, totally unable to appreciate the scientific method of collating and weighing evidence, and their books are full of conclusions based upon alleged facts which they forget are of their own devising. Who has not seen the itinerant phrenological lecturer with his pictures of skulls and portraits of noted personages, not one of which is authentic, all either manufactured outright or modified to suit the particular argument which the lecturer intends to advance? In the same way d'Arpentigny and Desbarrolles teem with instances drawn from the details of shape of the hands of notable personages long since dead, hands of which it is impossible that any accurate knowledge can exist.* Of actually living persons the data produced are comparatively few.

It is but one step from this loose making of bricks without straw to palmistry pure and simple, and this step is actually taken by most of the disciples of the new faith, so that we have the curious spectacle of a revival of the cheiromancy of the middle ages in the midst of the nineteenth century. The "astral fluid" again appears governing the seven planetary mounts; the *linea mensalis*, *linea*

*I cite a few noted at random: Artaxerxes I, Richelieu, Aristotle, Ariosto, Galileo, Frederick I of Prussia, Descartes, Newton, Byron, Paul I of Russia, Louis XIV, George Stephenson, Montaigne.

naturalis, *linea vitalis*, and *linea saturnia*, with much more of the nomenclature of the fifteenth century, are again in vogue. Fig. 1

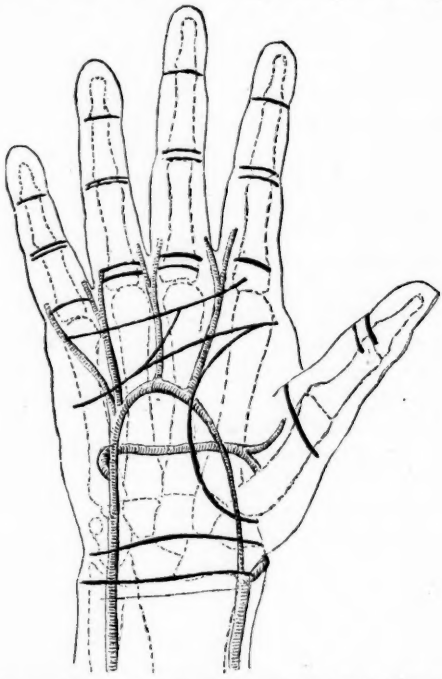

FIG. 1. Surface-markings on the palm of the hand. The thick black lines represent the chief creases on the skin. (Altered from Treves.)*

shows the principal lines of the palmar surface of the hand with their relation to the joints and the arteries. It will be seen that the *linea vitalis*, or life line, which marks off the ball of the thumb from the rest of the hand, is caused by the extensive range of opposability enjoyed by the thumb; that in a similar way the *linea naturalis*, or head line, which runs from the distal end of the life line across the palm, is caused by grasping with the four fingers, while the *linea mensalis*, or heart line, running from the index across the palm, is caused by the frequent flexion of the three outer fingers while the index remains open.

* The illustrations for this article have been kindly loaned from the "Reference Handwork of Medical Science," by the publishers, Wm. Wood & Co., of New York.

This natural interpretation is not enough for the cheiromants. They divide the line of life into sections which represent years of life, and predict illnesses and death according as an interruption or cessation of the line is found at these fateful points. A mark on the line of the heart indicates apoplexy, while a break in the line of the head naturally indicates a broken head.

This is not, as might be supposed, the mere chatter of some astrological quack of the fifteenth century, but is taken from E. Heron-Allen's Manual of Cheirosophy, London, 1886. The talented author of this surprising volume has recently visited the United States and lectured to admiring audiences in the principal cities. A considerable number of books of similar contents and value have recently been published in imitation of d'Arpentigny and Desbarrolles. As an example of the difficulties which beset one in attempting to practically apply the doctrine, I would say that in my own hands the "mount of Saturn" is absent, while that of Mercury is prominent. The work just cited states (page 208) that "if the mount of Saturn is quite absent the indication is of an insignificant 'vegetable' existence, unmoved by any great depth of feeling, and one which is continually oppressed by a sense of misfortune." I am, however, reassured by finding (page 214) that the "pre-eminence of the mount of Mercury indicates science, intelligence, spirit, eloquence, a capacity for commerce, speculation, industry, and invention, agility, promptitude in thought and action, and a penchant for travel and occult science."

As an example of the fatal inability to properly observe even the features which they consider essential, it may be mentioned that after examining a considerable number of the works of these authors I have in no case found a correct representation of the lines which mark the finger-joints, which are almost invariably as shown in Fig. 1, the folds next the palm being single for the index and little fingers, double for the others, the middle folds being double and the distal folds single. This may be verified at once by an inspection of one's own hand; but our cheiromants are too much occupied with the discussion of planetary influences to descend to exact observation.

It is well known that the notion of connecting a mystic symbolism with the lines and eminences of the palm is very old. The passage at Exodus, xiii, 16, "And it shall be for a token upon thy hand," is given in the Vulgate as "*et erit signum in manu tua*,"

and that at Job, xxxvii, 7, "He sealeth up the hand of every man," as "*Qui in manu omnium hominum signat.*" These are relied upon by palmisters not only as an evidence of the great antiquity of their science but also of its divine authenticity. Dr. William Lee, of this city, has recently called my attention to a translation of an old Sanscrit work, the *Ananga Ranza*, or *Ars Amoris Indica*, which contains the following, among other passages relating to palmistry:

"If an unbroken line run in the palm from the 'mount' or base of the little finger to that of the forefinger, it is a sign the bearer will live a hundred years. But the man in whose palm an unbroken line runs from the ball or cushion of the little finger to that of the middle finger should be considered as likely to live for a period of sixty years."*

There is here strong evidence that the gypsies brought their palmistry with them from India.

The absurdities of these authors certainly need not prevent an attempt at a rational physiognomy of the hand. While rejecting such puerilities as a minute study of the lines of the palm or a consideration of the mounts, every physician knows that certain general information, both with regard to the natural disposition of the individual and his condition at the time, can be obtained from the hand. The firm and moderately supple hand, with elastic skin and general tonic quality of the muscles, is very different both physiologically and pathologically from the dry tense hand, or the nerveless moist one. A considerable part of this difference depends upon the controlling influence which the nervous system has upon the muscles. As Sir Charles Bell remarks, "a thousand intricate relations are established with the hand throughout the whole frame," and if these have a constant tendency either in one direction or another the result will be in a general way made obvious. Physiologists are coming more and more to regard the nervous and muscular systems as a practically inseparable whole. It appears from the researches of Warner† and Mills‡ that during life forces are vibrating

* Page 82. The book was translated by "B. F. R." [Richard F. Burton?] and privately printed.

† Physical Expression. London and New York, 1886.

‡ Mills (T. W.). A Physiological Basis for an Improved Cardiac Pathology. N. Y. Med. Record, Oct. 22, 1887.

throughout the nervous system to the muscles, even while the latter appear perfectly quiescent, and that it is by these forces that the nourishment of the body is carried on.

Now, the musculo-nervous system of the hand is not a single simple apparatus, but several groups of organs combined together for harmonious action—organs which have become gradually differentiated from a more generalized form, each with its own history and rate of progress. We may therefore expect to find differences in hands according as these different sets of musculo-nervous organs have been developed more or less symmetrically and harmoniously, and if there is a predominance in the action of any one group we may expect to find a corresponding correlation in the rest of the body, including affections of the mind. Our first step towards a physiognomy of the hand, as in that of the face, must be to analyze the expression of the emotions.

Figure 2 shows, for example, a well-balanced hand, the flexors and extensors being about equal in their force, and giving a general

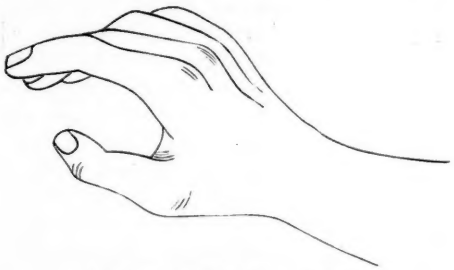

FIG. 2. The energetic hand. (Warner.)

tonic character which we recognize at once as indicative of healthy energetic action. Figure 3 shows the opposite of this, there being a relaxation of muscles, a lack of tonicity, and an indication of feebleness. We feel at once that these characteristics cannot be confined to the hands alone, but must extend to the whole system of the possessor. That they are not merely an accident of the attitude is seen by comparing these with Figure 4, which shows the healthy hand at rest.

While the flexor and extensor groups appear to be balanced in ordinary conditions of the hand, they are somewhat unequal in what may be called the *stability* of their functions. Any marked

disturbance of the nervous system is likely to act upon them unequally. This is well seen in the case of chronic lead poisoning, with its accompanying "wrist-drop," caused by the paralysis of the extensors. There would seem at first to be no especial reason why a poison introduced slowly into the system should exercise a selective action on one group of muscles rather than another. It is probable that in this case, as in many others throughout the body, the group which is the oldest, phylogenetically speaking, which has, that is to say, the longest history as an active important series of organs, is the one which resists longest; and that, on the contrary, the group which has been most recently developed is the first to yield to disturbing influences. When we come to follow down the line of man's ascent in the animal scale there can be no doubt that the flexor group, as organs of prehension, have had a much more significant part to play than the extensors. For long ages they have had vibrating through them some of the strongest influences of which the body is capable; consequently they have acquired an ability to resist disturbance similar in some respects to that possessed by an animal that has become adapted, by long struggle and hereditary transmission, to an environment fatal to those not having such training.*

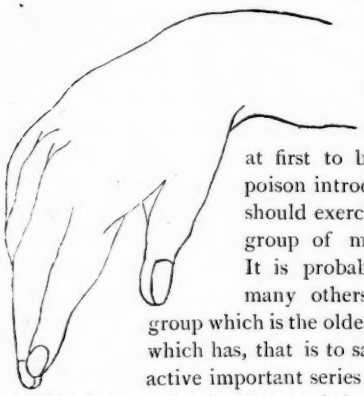

FIG. 3. The feeble hand. (Warner.)

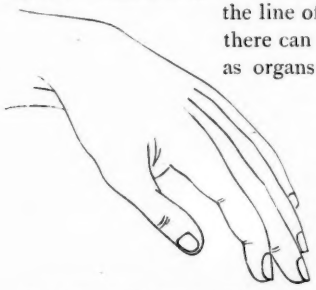

FIG. 4. The hand at rest. (Warner.)

* In a paper read at the Buffalo (1886) meeting of the American Association for the Advancement of Science I ventured to call attention to this law of comparative stability, instancing, among other cases, the extensors of the leg, the thyro-arytenoid muscles of the larynx, the nervous system in general, especially the speech and writing centers of the brain, and the premaxillary bone. Allen had previously called attention to similar facts with reference to the other bones of the skull, and Mills (op. cit.) mentions this law in connection with the heart.

In the hand, therefore, the most recent and highly specialized muscles are the first to be affected by any pathological disturbance. The lumbricales and interossei easily succumb, next the extensors. This is especially seen in cases of progressive muscular atrophy, the human characteristics gradually disappearing and the hand assuming more and more the attitude and shape of an ape's paw.

The predominance of the flexors is at once seen in case of any powerful excitation of the nerve-centers causing spasmodic action, the hand being then tightly clenched and the thumb drawn inward toward the palm because of the great number of strong flexors attached to it. The real expression of mental agony is not the conventional wringing of the hands by simply sliding one over the other, as in the act of washing them, but the clutching of one hand and passing it through the other with a convulsive twitch as the ends of the fingers are reached. This expressive fact in the physiognomy of the hand is often made use of by actors and artists. Madame Bernhardt's hands are as expressive as her features. The strong action of the thumb causes it to be thrown inward during the death struggle of those who have died a violent death.*

In many cases of pathological conditions of the nervous system an irregular action of the flexors is seen. Fig. 5 shows a form

Fig. 5. The nervous hand. (Warner.)

which is frequently found and may exist temporarily as an expression of passing emotion.

* This fact, when translated and exaggerated, reads as follows in the terms of the new science: "At the approach of death the thumbs of the dying, struck, as it were, with the vague terror of approaching dissolution, fold themselves beneath the fingers—sure sign of the nearness of the final struggle." (D'Arpentigny, op. cit.)

Again, the hand may show in temporary attitudes forms of expression which are derived from gestures once useful for protection or preservation and now surviving as relating to a higher form of mental emotion. The expression of fright is associated with a sudden extension and raising of the hand, so as to repel the object of horror, protect the person, and place the hand in a position for the flexors to be put effectively in play. The attitude is shown in Fig. 6 and is used not only for actual protection, but also to express fright where no possible danger can exist to the individual. I was told by a lady recently that from the window of a car going at full speed she saw a woman throw her hands into this position and knew from that alone that some accident had occurred. The engine had struck a wagon crossing the track, killing the driver and horse. It is by the constant repetition of muscular states that types of hands come to be formed, the muscles by their pull and the nerves by their constant trophic influence shaping the very bones. There is, however, another class of differences which represents what may be called reversive characters, the hand showing features common to forms which lie lower in the biological scale. As instances of this may be mentioned a predominance of hair, fingers unusually short and thick or with strangely curved nails, an unusually small and undeveloped thumb. There is considerable evidence tending to show that people who possess reversive characters are more common among those classes of society properly designated low. Like similar characteristics of face—retreating forehead, heavy frontal sinuses, strong zygomatic arches, prognathous and heavy jaws—they are unusually common among criminals and the insane. This simply means that a correlation of this kind is frequent, not that the two have any real causal connection. They no doubt often exist in those of perfectly sound mind and without the slightest tendency to crime.

FIG. 6. The hand in fright. (Warner.)

The comparative length of the index finger has received some

attention as a reversive character. It is usually shorter than the ring finger, as in the anthropoid apes, sometimes equals it, and rarely exceeds it. Ecker,* for reasons which are not quite clear, considers that unusual length is a progressive character. He finds it more frequent in women and holds that it is usually correlated with a high type of mind. Grüning† recently made some 200 very exact observations to determine whether the peculiarity had any ethnological value, and in the main confirmed previous results. I have myself made a considerable number of examinations of hands for the same purpose and find that the matter is more difficult of solution than would at first appear. If the fingers are not held firmly in a definitely chosen position, I think the results obtained very questionable, for a slight abduction or adduction of the hand causes the relative length to vary considerably. In 85 individuals examined I found the index to equal or exceed the annularis in 9 cases. There was no perceptible difference in the two sexes. Braune and Fischer‡ have recently shown that conclusions drawn from the living hand are not correct, as the measurements cannot be accurately made from the axis of motion of the joints. They examined 40 skeletal hands and found that in no case did the index equal or exceed the medius in length. When the metacarpal bone of each finger is counted as a part of the digit, the index is invariably longer.

An error is likely to arise by assuming too hastily that a short index is an invariable character in apes. In all cases of this kind a generalization cannot properly be made until many observations have been recorded. The number of apes carefully observed must be comparatively few, and it seems not unlikely that, if a sufficient number were examined, the range of variation would be found to be quite as great as in the human species.

A number of interesting traditions may be noted concerning the different fingers of the hand. The thumb being the strongest of the digits naturally comes in for a large share of these. Many illustrations might be given of its use as a symbol either of religious

* Ecker (A.). Ueber einen schwankenden Charakter in der Hand des Menschen, Arch. f. Anthrop. Braunschw., 1875–'6, VIII, 67.

† Grüning (J.). Ueber die Länge der Finger und Zehen bei einigen Völkerstämmern. Ibid, 1885–'6, XVI, 511.

‡ Achiv. f. Anat. u. Entwickelungsgesch., Heften I & II, 1887.

belief (first person of Trinity) or of virile force. Turning the thumb inward toward the palm was practised in Northumberland to avert the terrors of witchcraft, and it was customary to so fold inward the thumbs of the dead, as the fingers in that position formed a similitude of the Hebrew character commonly used to denote the name of God.*

A similar application of the thumb to avert the evil eye is mentioned as occurring in Andalusia.† In this case it was used to make the "mano in fica," being placed between the index and middle fingers. Children wear amulets of this kind, which are known as "fijas." Mallery ‡ notes the use of this sign in the Neapolitan gesture-language to indicate the pudendum muliebre. It is used among school boys in Western New York, New England, Pennsylvania and Michigan with an obscene meaning attached to it. It is not at all impossible that this "mano in fica" may be a survival of some ancient phallic symbol-like that of the horseshoe. It is well known that the phallic worship was not necessarily obscene, but had as its essential quality a reverence for the life-giving powers of nature as opposed to all noxious death-dealing powers. A closed fist with two fingers extended is still a charm found over church doors in England, and is also considered phallic.§ In Egypt, Greece and Italy a representation of the phallus was generally used against the evil eye.‖

Another digit which has an interesting folk-lore history is the fourth—that is to say, the annularis or ring finger. It was used even in Greek and Roman times to carry a ring, and the reason for this becomes obvious enough when we examine the anatomy of the extensor tendons, the tendon for the fourth digit being attached by cross-bands to those of the third and fifth and the motion of the finger thus considerably confined. A practical illustration of this can easily be made by attempting to extend the fourth digit, while the third and fifth are held forcibly flexed. From this more

* Brands' Popular Antiquities.

† Notes and Queries, 6th ser., XII, 32.

‡ Sign language among North American Indians. Report of Bureau of Ethnology, 1879-80.

§ Notes and Queries, 6th ser., XI, 413.

‖ Westropp (Hodder M.). Primitive Symbolism as illustrated in Phallic Worship, p. 62.

limited range of independent motion it follows that a ring worn upon this finger is less likely to interfere with the free use of the hand than upon any other.

There is, as usual, a mystical signification ascribed to this. One idea is that as the thumb, index, and middle fingers indicate severally the three persons of the Trinity, the next finger in honor is given to the wife, and the wedding ring is therefore assigned to it. Many authors state that it was anciently supposed that a *nerve* passed directly from this finger to the heart.*

I have been somewhat puzzled to account for this, as it is well known that the importance of the nerves as conveyers of force, although vaguely surmised by old anatomists, was not fully recognized until comparatively modern times. On further investigation it seems probable that it was a *vein* to which was assigned the office of connecting the finger with the heart.

In the marriage service the Book of Common Prayer gives explicit directions that "the Man shall put the ring upon the fourth finger of the Woman's left hand," and the spousal manuals of York and Salisbury give the reason, "Quia in illo digito est quædam vena procedens usque ad cor."‡

In the Treatise of Spousals, by Henry Swineburne (1590–1600?), printed 1686, occurs the following passage:‡

"The Finger on which this Ring is to be worn is the fourth Finger of the left hand, next unto the little Finger; because by the received Opinion of the Learned and Experienced in Ripping up and Anatomizing Men's Bodies there is a Vein of Blood which passeth from that fourth Finger unto the Heart called *Vena amoris*, Love's Vein. And so the wearing of the Ring on that Finger sig-

* Hyrtl. Topographisches Anat., 7th edition, Wien, 1882, Vol. II, 513.

Aulus Gellius, Noctes Atticæ, lib. x, cap. 10, has the following passage: "Veteres Græcos annulam habuisse in digito accepimus sinistræ manûs qui minimo est proximus. Romanes quoque homines aiunt, sic plerumque annulis usitatos. Causam esse hujus rei Appianus in libris Aegyptiacis hanc dicit: quod invectis opertisque humanis corporibus, ut mos in Aegypto fuit quas Græci ἀνατομὰς appellant, repertum est nervum quandam tenuissimum ab eo uno digito de quo diximus ad cor hominis pergere ac parvenire. Propterea non inscitum visum esse, eum potissimum digitum tali honore decorandum, qui continens et quasi annexus esse cum principatu cordis videretur.

† Maskel. Ancient Liturgy of the Church of England, 2d ed., clv, note.

‡ Cited in Notes and Queries, 7th ser., iv, p. 285.

nifieth that the love should not be vain nor fained, but that as they did give their Hands each to other, so likewise they should give their Hearts also, whereunto that Vein is extended."

I have seen it stated that there is no anatomical basis for this idea, but those who have held this have surely overlooked the vena salvatella of the old anatomists. This vein arises directly at the root of the ring finger in the fourth metacarpal space, runs over the back of the hand, and can be traced upward through the basilic or royal vein, the axillary, the subclavian, the innominate, the descending cava, to the heart. Hyrtl* derives the name salvatella from a corruption of the Arabic name given by Avicenna as Alusailim=vena salutis. If this be correct we may see here the same idea, the vein of health being very naturally the one directly connected with the heart. As this vein is a very prominent one, usually standing out clearly when the hand is pendent, it is not surprising that it should have attracted the attention of those who busied themselves with the symbolism of the hand.

It seems incredible that this should not have been clearly shown by some one before this, and I am quite prepared to find that I have been anticipated in my explanations, as happens very frequently to those who tread such well-worn paths as I have travelled in this paper.

DISCUSSION.

The above paper was read before the Anthropological Society of Washington May 4, 1886, and was discussed by Messrs. PETERS, MASON, MALLERY, and FLETCHER.

Prof. MASON spoke of Dr. Hassenpflug, who has professed to cure various diseases with his hands by bringing them in contact with his patients. He also asked whether Dr. Baker had seen any comparisons of the length of forefingers and ring fingers; in his own case he found that his ring finger was slightly longer than his forefinger; in most cases they are about the same length—a proof, it is said, of our simian ancestry. Some persons find that on one hand the forefinger is slightly longer than the ring finger, while on the other hand they are of the same length. He then referred to dermal topography and its use by the police and others as a means of identifying persons.

* Lehrbuch der Anat., 17 ed., p. 1073.

Col. MALLERY spoke of the mystic influence of the thumb mentioned by Dr. Baker. He had recently attended a lecture on the system of Delsarte in which the same superstition appeared. Delsarte, it was said, determined to find a sign of death, had visited all the dissecting rooms and hospitals, but he could find nothing to distinguish death from catalepsy. At length he declared that in cases of death the thumb was always flexed and rested on the palm, but he said nothing about the fingers being closed on it. This fundamental discovery was wholly fallacious, such position of the thumb, at the most, attending only sudden and violent deaths, and also catalepsy.

Dr. FLETCHER spoke of us as owing nearly all our present system of measurement to the parts of the hand. He then gave what he considered a fanciful derivation of the word poltroon, *pollice truncato*, ascribed by some to the old custom of cutting off the right thumb of a vanquished foe. He next called attention to the fact that one other organ, the tip of the tongue, was as sensitive as the points of the fingers. This has been shown by slightly opening a pair of dividers and placing the points on the tip of the tongue, which could easily detect the presence of two points instead of one. In his opinion the closed thumb as a sign of death is without value. But it is acknowledged that those dying violent deaths have the fingers and thumb tightly clenched.

THE Journal of the Anthropological Institute of Great Britain and Ireland for August, 1887, prints a description of the cerebral hemispheres of an adult Australian male, by H. D. Rolleston, B. A., Scholar of St. John's College, Cambridge.

It is to be regretted that few brains of Australian aborigines have, so far, been subjected to the careful study which modern science demands, since the organ of thought in such a low race as the Australians may be supposed to present many marked and instructive contrasts with the same organ in the higher races.

Mr. Rolleston has subjected the brain in his possession (taken from a patient in the hospital at Adelaide) to a careful examination and has recorded in concise language the results of his study. The author estimates the weight of the brain at the time of death at 43

ounces. He tells us that the average weight of six Australian brains was found to be 41 ounces, and he continues:

"The weight of the brain as a racial character is a subject which has attracted a good deal of attention, and, as a result of colossal tables, it may be taken that the average European brain-weight in males is 49 ounces. The average weight of the negro brain is about 44.3 ounces, which it will be seen is in excess of the primitive Australian."

He notices the general greater simplicity of the convolutions of this Australian as compared with the average European brain, and, especially with regard to the frontal region, he says:

"The convolutions of the frontal lobe, which is connected with intellectual processes, are seen to have a marked antero-posterior arrangement, to be four instead of three in number, and to be separate—not to join each other at every turn and twist, as is so notably the case in the described brains of many eminent men, and generally of the more civilized nations. The simplicity of the frontal region is a point of importance, and may be considered as characteristic of a primitive brain. The frontal lobe being associated with higher faculties, it has been thought that the relation of amount of brain substance in front and behind the fissure of Rolando is of almost equal importance with the features mentioned above; but in this brain the relation of amount of brain-substance in front and behind the fissure of Rolando was much the same as in an average European brain."

Mr. Rolleston's paragraph with regard to the speech center is of especial interest:

"The island of Reil is exposed on left side; this exposure is a condition found in primitive brains: thus Marshall (Phil. Trans., 1864) figures it in the brain of a Bushwoman, and quotes other examples. The exposure of the island of Reil implies that the surrounding gyri are ill-developed. Broca's convolution is thus shown to be defective, a point of interest in an Australian savage whose language is primitive, as shown by its unclassified character."

ON THE CHANE-ABAL (FOUR-LANGUAGE) TRIBE AND DIALECT OF CHIAPAS.

BY DANIEL G. BRINTON, M. D.,
Professor of American Archæology and Linguistics in the University of Pennsylvania.

Of the numerous branches of the Mayan linguistic stock that remaining the least known is the Chane-abal, Chanabal, or Chañabal, spoken in a remote corner of the Mexican State of Chiapas. The explanation of this ignorance is easy enough when we consider how small is the tribe, how isolated its locality, and how indifferent the ordinary traveler is to ethnological and especially linguistic subjects. I am gratified, therefore, to be able to offer sufficient material about this people and their tongue to dispel various errors found in the authors, and to assign to both their correct ethnologic positions.

Name and Synonyms.—In his "Geographical Description of Chiapas," Pineda describes the city of Comitan in these words: "Its population is a mixture of whites and natives; the latter speak four languages besides the Spanish, and on this account their maternal tongue is called *Chañabal*, and is compounded of the Zotzil, Casdal, Maya, and Trokek."*

This extraordinary statement has given some trouble to later writers. Nowhere else do we hear of any such languages as the *Casdal* and the *Trokek*. Orozco y Berra, indeed, was so affected by their solitary appellations as to exclaim, "These languages have disappeared, and their names alone remain to recall those ancient tribes, once possessors of the land, who gave way to the later nations who precipitated themselves upon the territory of Chiapas," etc.† Pimentel also classifies these among the extinct languages of Mexico,‡ and after him various later writers.

**Descripcion Geográfica de Chiapas y Soconusco.* Por Emeterio Pineda, p. 58. (Mexico, 1845.)

†*Geografia de las Lenguas de México.* Por Manuel Orozco y Berra, pp. 21, 172.

‡*Cuadro Descriptivo de las Lenguas Indígenas de México.* Por Francesco Pimentel. Tomo III, p. 280.

In view of the dissemination of this opinion by such well-known authors on Mexican linguistics, it is worth while saying that *Casdal* is nothing more than a blunder for Cakchiquel and *Trokek* for Zoque, and both Cakchiquel and Zoque are well-known tongues, still spoken by thousands of active citizens. This will be evident by a study of the vocabulary I present, and suggests itself, indeed, from the names themselves.

Another error of Pineda is to assign the name Chañabal to the language spoken at Comitan; and this, too, is repeated by Orozco y Berra, Pimentel, and others down to the Count de Charencey and Mr. Pilling. The proper form is *Chane-abal*, which is shortened to *Chanabal* in the writings of Father Ximenez,* who is the first to mention the tongue (about 1720), and in the Bibliography of the Abbé Brasseur de Bourbourg.

The name *Chane-abal* means, as Pineda says, "four languages," *chane* being the numeral *four*, and *abal*, literally, *word* or *words*, and, by extension, *language*.

As synonyms, Orozco y Berra gives the names *Jojolabal*, *Jocolabal*, and *Comiteco*.† Evidently the two former are modifications of the same, and both are corruptions of the term *tohol-abal*, which means, to speak clearly, distinctly, or the clear, distinct language.

I find a note in the late Dr. Berendt's papers on these names, to this effect: "The two names which the people who speak this tongue themselves give to it are *Chaneabal* and *Toholabal*, and, in preference, the latter. They do not say *Chañabal* nor *Chanabal*, but distinctly *Chaneabál*. The words *tohol abal* mean 'to speak straightly, clearly, or distinctly;' and they do speak it in this manner."

The term *Comiteco* is merely an adjective in Spanish form from the place name *Comitlan*, itself a Nahuatl word, compounded of *comitl*, vase or vases, and *tlan*, at: "the place of pots," doubtless referring to some ancient active industry in pottery which was there carried on.‡ In general, the natives refer to themselves as "Comitecos," whether they reside directly in Comitan or not.

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* In his *Arte de las Tres Lenguas, Cakchiquel, Quiché y Zutuhil*, quoted by Brasseur, *Hist. des Nations Civilisées du Mexique*, Tome I, p. 10, note. See also Brasseur, *Bibliothèque Mexico-Guatemalienne*, pp. 36, 119.

† *Geografía de las Lenguas de México*, p. 167.

‡ Comp. Buschmann, *Ueber die aztekishen Ortsnamen*, s. 807.

Bibliography.—The sources of our knowledge of the Chane-abal may be briefly stated.

The oldest is comparatively recent. It is a *Confesionario y Doctrina Christiana*, in the dialect of Comitan, translated by a Dominican, Father Domingo Paz, in 1775.*

A second *Confesionario* was prepared in 1813 by Manuel Camposeca, apparently a native, for the use of Father Benito Correa, also in the Comitan dialect. Both these were secured by the Abbé Brasseur de Bourbourg and formed part of his library at its sale. The Abbé also stated in a letter published in the *New York Tribune*, November 21, 1851, that he had obtained a manuscript grammar of the tongue, but of this I do not find any mention in his later writings. The *Confesionario* of Camposeca has been published by the Count de Charencey in the *Revue de Linguistique*, July 15, 1887.

In 1871 the Abbé Brasseur announced the above as the only extant monuments of the tongue. The late Orozco y Berra, however, had in his possession a translation of the Lord's Prayer into Chane-abal, which was published by Pimentel in his work already quoted.

My own special facilities for the study of the tongue are derived from two manuscripts. One of these is entitled *Vocabulario Comparativo de las Lenguas Zoque de Tuxtla, Zotzil de San Bartholomé de los Llanos, Chaneabal de Comitan, per Don José Maria Sanchez, Cura de Ocosocoantla.* It is the original, in-folio, not dated, but apparently about 1850 or 1860, and contains 261 words and phrases in Chane-abal. The second is a small quarto of 25 pages, containing a vocabulary of about 500 words, obtained by the late Dr. Karl Hermann Berendt in Tuxtla Gutierrez in 1870. His informants were a Spanish Mexican lady, Doña Agnede de Figueroa, and two of her servants, all of whom had passed years in Comitan and spoke its dialect fluently. The Cura Sanchez expresses the sounds with the Spanish alphabet, while Dr. Berendt employs that which he had devised for this group of tongues.

Geographical Distribution.—The Chane-abal is confined to the *partido* of Chiapas, known as the *Partido de la Frontera*, on account of its proximity to Guatemala. This *partido* includes Comitan,

* *Confesionario y Doctrina Christiana en Lengua Chanabal de Comitan y Tachinulla en las Chiapas.* See Brasseur, *Bibliothèque Mexico-Guatemalienne, p. 119.*

Zapaluta, Chicomucelo, and Socoltenango. In the last Zotzil is the prevailing tongue—in the others, Chane-abal.* According to the census of 1862 the natives speaking the latter numbered about 13,000, which is approximately the figure obtained by Pineda twenty years before, and probably remains to-day nearly the same. On the north they adjoin the territory of the Zotzils and Tzendals, while both to the east, south, and west they are separated by wide uninhabited areas from the Maya dialects of Guatemala and the Nahuas, etc., of Soconusco. The statement advanced by Brasseur that the Chane-abal is spoken in the extreme north of the province of Huehuetenango, in Guatemala, remains unsupported by evidence;† and the town or place called *Tachinulla*, in the title of Paz's *Confesionario*, is not mentioned on any map nor by any other author.

Ethnological Traits.—Pineda gives this tribe the credit of being the most industrious of any in the department of Chiapas. They devote themselves to raising stock, to agriculture, to the manufacture of basket work, straw and cotton goods, to distilling brandy from the maguey, and to hunting. Formerly there were mining industries in this locality, and a mysterious rumor continues among the whites that the Indians still know rich mines of gold and silver, but that they keep them secret, and send the precious metals they obtain far into Guatemala to be sold.

Physically, Dr. Berendt describes them of small stature, less robust than the Tzendals and Zotzils, darker in hue, and with a more pronounced mongoloid expression. Pineda says that the climate is less favorable to the growth of the men than of the women, and hence that the latter appear to best advantage.

Mentally, they are inoffensive and mild in disposition, not prone to quarrels, but of active intelligence.

Their country is rather level, with numerous streams and swamps, and is in consequence not healthy, especially to Europeans.

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* All these places are mentioned by Remesal, in 1617, as under the jurisdiction of the Dominican Convent of Copanabastla. *Historia de Chiapas y Guatemala, p. 748.*

† Compare Brasseur, *Arch. de la Com. Scientif. du Mexique*, Tome I, p. 130, and Stoll, *Ethnographie der Republik Guatemala*, p. 88. Berendt, in his *Geografia de las Lenguas Maya-Kiche, MS.*, gives no support to the assertion.

Phonetics.—The phonetics of this dialect reveal at once its close relationship to the Mayan linguistic stock. It has the well-known "cut" letters, the "consonantes heridas" of Spanish authors, *k'k, p'p, t't, t'ts, t'tx*, which may be described as a repetition of the sound of the single letter, with a slight hiatus between the two. There are also the gutturals, the *ch'*, as *ch* in the German *Buch*, and *hs*, and the soft *x*, like *sh* in *shore*.

The vocabulary prepared by Dr. Berendt was written by him in his own "Analytical Alphabet for Mexican and Central-American Languages," which contains a number of letter forms not obtainable in type.* In transcribing it I have indicated the cut letters and gutturals by an apostrophe, as *kk'* and *ch'*. The other principal peculiarities of this alphabet are: *'ts* = German *x*; *tx* = the English *ch* in *church*; *ks* = the English *x* in *tax*. The vowels have their Continental sound, but when one is written above the line it is to be pronounced in one syllable with the vowel following and without losing its independent character.

Comparisons.—A feature of much interest in Dr. Berendt's vocabulary is the extensive analogies he has indicated between the Chane-abal and other dialects of the Mayan group. These are distinguished by the following initials:

C., - - - the Cakchiquel.
Ch., - - - the Chontal.
E., - - - the Echolchi, or Chorti.
H., - - - the Huasteca.
I., - - - the Ixil.
K., - - - the Kiche or Quiche.
M., - - - the Maya.
Mm., - - the Mame or Mam.
P., - - - the Putum or Chol.
Po., - - - the Pocoman.
Tz., - - - the Tzendal.
Z., - - - the Zotzil.

All the above are dialects of the Mayan group. Affinities of tongues beyond this group are indicated by—

Mex., - - - the Mexican or Nahuatl.
Zq., - - - the Zoque.

* This alphabet was published, lithographed in fac-simile, by the American Ethnological Society, in 1869.

Comparative Vocabulary of Chane-abal, from MSS. of Dr. C. H. Berendt, 1870.

Achiote, ch'ŏŏx.—Ch., Tz., Z., P., kuxub, M.
After, tsanto.—See *before.*
Aguacate, on.—M., Tz., Z., un, Ch., um, P., och', K.
Alive, saganil.—sasapo, Zq.
All, petsanil.—See *little, few.*
Always, chaxan ya—taxtal, Z.
Animal, txanté—txon, Z.
Anona, ke^{u}ex.—Z.
Ant, xanitx.—Tz., Ch., Z., P., M., C., K.
Arm.—See *hand.*
Armadillo, ibo^{i}.—C., ibŏtx, M., Ch.
Arse, anus, top—top, to bore, M.
Artisan, ayatel—lit. "he has business."
Ashes, tan.—M., Tz., K., Ch.
Atole, māts.
Bad, mi lek—ma lek uk, not good, Tz, Z.
Banana, lobal.—Z.
Bark, patik te'—pat te', P., Z.
Basket, mŏtx.—Tz., Z.
Bat, ^{u}etx (?)—See *wing.*
Bean, txenek.—Z, Tz., H.
Beard, itsimal—isīm, Z., ismatxi, C.
Beard (of the chin), ch'uti—xŏkti, Ch.
Bed, tt'sat.—C., tt'xak, M., P., tsees, Zq.
Bee, txachnul, ahau txab—yikil kab, M., yaltxab, Tz.
Before, ^{u}anto'.—Qy? Spanish.
Belly, lukum—tsek uku', Zq.
Below, koel—kaa'i, Zq.
Bench, kan—kŏnŏts, Zq., kanche, M.
Bitter, kk' a^{a}.—M., K., tt'xa, Z, txach', Ch., kk' ai, H.
Black, kk'ikk'.—C., K.; ik, Ch., Tz., Z, etc.
Bladder, be txulal—lit. passage, urine.
Blind, tupel sat.—See *eye.*
Blood, txik.—Tz., Ch., Z., P., M., etc.
Bone, bak.—M., Ch., Tz., Z., P., C., K., Zq.
Brain, txich'nab—txinam, Z.

Branch of a tree, kk'ab té—lit. arm, tree.
Brandy, pox—opox, Z., petxtio, P.
Breast, snak ŭ chol—uakk'ux, C., K.
Bridge, ka té—k'am, C., K.
Brother, elder, bankil.—Z., Tz.
Brother, younger, ich'tsinal.—Tz., Ch., Z., M.
Bug (chinche), pŏtx—Zq., Z.
Cacao, kaka—M., Tz., P., Z., Ch.
Calabash, for eating, kk'um.—M., K., C., tt'xum, Tz., Ch., Z., P.
Calabash, for water, tsu.—Z., K., C., Ch., M.
Cat, mistu.—Zq., M., Tz., Ch., Z., P., C., K.; all from Nahuatl *miztli*, the American lion.
Cave, kk'en—txen, Tz., Ch., Z., P., M.
Cedar, txuch'te'.—Ch., P., tente', Z., kk'uche, M.
Chayote, txoyol.
Cheek, txoch'—txo, Ch., Z., Tz., P.
Chemise, kolob.
Chief, leader, olom, achal.—See *head* and *master*.
Child, a' la.—Tz.; P., Z.; see *son*.
Chile, itx.—Ch., Tz., Z., P.; ik, M., C., K.
Church, na Dios—lit. house, God.
Clay, lum.—See *earth*.
Cloak, nok.—M., Z.
Clothes, in general, nok.—M., P.
Cloud, ason.
Coal of fire, txakalkakk'.
Coast, bank, sti ch'a.—See *mouth*, *water*.
Cock, rooster, kere mut—kelemut, Ch. comp. *hen*.
Cold, tsae' txel—tsu^{u}an, P.; keel, M.
Collar, g^{u}alal—^{u}al, Z.
Comal (a flat dish), samet.—Tz., semet, Ch., Z., P.
Comb, xixab—xichŏb, Ch., K.
Corn, ear of, ch'al.—K., C.
Cord, rope, yagil txi.—See *hemp*.
Cornfield, alach'.
Cotton, teinok—tuxnok, Z., tinion, P.
Coyote, wolf, ŏgil—ŏkk'il, Z.
Crab, tenten.
Cricket, txultxul—txil, Z., C., K.; tsiltsim, H.

Daughter (of a woman), al akix.—Comp. *son.*
Day, kk'agú—kk'atzal, Z.
Dead, txamta—txamel, Tz., Z., Ch., P., kimen, M., etc. See *sick.*
Deaf, pakatxikim. See *ear.*
Deer, kuch'lal txech'.—See *woods;* txech', Mm., Z., Tz., etc.
Devil, pukuch'—temptation, Z.
Dish, olla, oxom.
Dog, tt'si.—Tz., Z., P., C., K., Po.
Drawers, breeches, ^{u}ex.—M., Ch., Tz., Z., P., C., K.
Dumb, mix kumani—lit. "he speaks not."
Ear, txikin.—Tz., Ch., Z., P., etc.
Earth, land, lum—M., Tz., Z., P., etc.
East, the, bauaxel kk'agú.
Egg, nolob—moloch', Po., C.
Elbow, xich' kk'ab—xŭch'ku, P. See *arm.*
Entrails, txan lukum—lit. snake, belly.
Excrement, kŏt.
Eye, sat—Z., sitch, Tz.
Face, sat.—See *eye.*
Far, nachat—C., K., Ch., P.
Fart, tsis—Z., kis, M., C., K.
Fat, tolan, pim—pim, M., C., P., Z., K.
Father, tat—Zq., Tz, Po, etc.
Fear, txi^{u}el—Z.
Feather, kk'ukk'um—M., Tz., Z., P., C.
Female, men—ma, Z.
Finger, ni kab tik—lit. "son of the hand."
Finger, little, yal kk'ab.
Fire, kakk'—M., Ch., Tz., Z., P., C., K.
Fish, txa^{i}—Tz., Z., P.; kai, M.
Fisherman, mul^{u}anum.
Flea, kak—C., K., tt'xik, M., tsak, H.
Flesh, meat, baket—Tz., Z., Ch., M.
Flint stone, tonil kich'k.—See *fire.*
Flower, nitxim—Z., Tz., P.; nikté, M.
Fly (a), us—Zq., Z., K., M., etc.
Foam, froth, puux—puluch', C., K.; upu, Zq.
Foot, ŏk—M., Ch., Tz., Z., P., E., Po.
Forehead, patan—pan, P., Ch.; palak, K., Mm.

Fork (of a tree, etc.), ŏ^{i}—Z.
Fox, uch'txum—utx, Ch., Z., P., M.
Frog, txutx—Z.
Fruit, lekk'ul té—kuti, Zq.
Gall, k^{u}a—M., C., K., Ch., H.
Girl, akix.
God, chu^{u}tik—txultatik, Ch., Tz.
Good, lek—Ch., Tz.
Goose, petx—Z., Zq., Tz.
Grass, sacate, ak—Tz., C.
Green, yax—M., Tz., Z., P., etc.
Guayava (a fruit), pata—Zq., Ch., pōtŏp, Z.
Gum, resin, yalmix té.—See *milk, tree.*
Hail, bat—M.
Hair, tsots—M., Tz., Z., P.
Hammock, ăk—Z.
Hand *or* arm, kk'ab—M., Tz., C., K., Ch., kk'ŏ, P., kŭ, Zq.
Hand, left, kexan kk'ab.
Hand, right, ^{u}ael kk'ab.
Hard, tsats—Z., Ch.; txitx, M.
Hat, pisolom—pixol, Z. See *head.*
Hatchet, ētxēch'—ekk'el, Z.; ykach', C.
He, that one, yena.
Head, olom—cholom, C., H., chol, M., Tz., Z., P., E.
Heart, snich'koch'ol.—See *breast.* Kuskolot, Mm.
Heart, of an ear of corn (cob), bakal—M., Tz., Z., P., Ch., H.
Heaven, sky, kultxan—txultxan, Tz., kaan, M., kach', C., K.
Heavy, al—M., Ch., K., Z.
Hell, katimbak—Z.
Here, ili—li, Z., Tz.
Hemp, txi—Z., Tz., P.
Hen, nia mut—mutiŏ, P.
High, txaan—txan, P., caanel, M.
Hill, ^{u}its—M., Ch., Tz., Z., P., I., Mm.
Hog, txitam—Tz., Ch., Z., P., etc.
Honey, txab—Tz., kab, M., C., K.
Horn, xulub—M., Tz., P., Z.
House, na—M., Tz., Z.
How? chastal.

How much? ch'ai—M., Ch., H.
How often? cha^{i} elele—ch'ail, H., ch'aite, M., ch'ai tual, I.
Hungry, ^{u}ain—^{u}aich', C., K., M.
Husband, tatam.
I, kena.
Jar, tsimá—Zq., P., K.
Jar for water, tt'xub.
King, chief, ahau—M.
Lake, istiman ch'a—lit. shut-in water.
Large, nig^{u}an—nim, C., Po., Mm.
Leaf (of corn), ch'öch'otx—Tz., Z., ch'omotx, Ch., P.
Leaf (of a tree), pa^{u}ilté.—See *tree*.
Leather, tt'sum—C., K.
Leg, etxmal.
Light, mialuk—lit. "it is not heavy" (?); mooluk, Z.
Lightning, txauk—Tz., Z., M.
Lime, tan—Ch., Tz., Z., P.; taan, M.
Lion, txoch'—Tz., koh, M., C., K.
Lioness, si—M., Ch., Tz., C., etc.
Lip, bakel ti—lit. flesh, mouth.
Little (a), tusan—uxan, Zq.
Liver, tsech'yub—sekum, Z.; sase, C., K.
Lizard, och'kots—Tz.; otxo, H.
Lizard, large, ayin—M., Mm., Tz., Z., P.
Load, kutx—M.
Locust, kŭch'lūb—kk'ulum, Z.
Louse, uk—M., C., K., Ch., Tz.; uts, H.
Magician, pūkuch'.—See *devil*.
Maize, ixim—M., Tz., Ch., Z., P., C., K., Po.
Maize, green, ăch'an—Tz., Z.
Male, kerem.—See *boy*, *youth*.
Man (vir), uinik—Tz., Ch., Z., P.
Market place, plaza, txinub—txiuitz, Z.—See *town*.
Master, ruler, ach'ual—Tz., Z.
Mecapal, pek—Tz., Z.
Messenger, ch'ekubal.
Mat, pop—M., Ch., Tz., Z., C., K.
Milk, yalel mix—lit. water, teat.
Mill, millstone, txa—txam, Z., M., Ch., etc.

Money, takk'in—M., Z., P.
Monkey, bats—Z., M., P., C., K.
Monkey, max—M., Ch., Z., P.
Moon, ixa^{n}—Mm.; ixacha^{n}, "queen," M.
Month, ixa^{n}.—See *moon*.
Mother, nan—Tz., Zq.; na, M., Ch., etc.
Mouth, ti—P., Ch., tich, Z., txi, M., C., K., Po., E., Mm.
Much, ch'itsan—kk'i, C., K.
Much, very, ^{n}achel.
Mud, lokol—lukk', M.
Nail (of finger), etx—Tz., P., Z., M., etc.
Name, bil—Tz., Z.; bi, C., K., M., etc.
Narrow, txin sat.—See *eye* and *small*.
Navel, muxuk—C., K., Ch., P.
Near, moch'an.
Neck, ch'nuk—nuk, Tz., H.
Nest, tsŏ—nose, Zq.; zok, C., K.
Net-bag, enub—nuti, Tz., P.
New, ach'kats—ăăts, Z.
Never, mich'ai nach'ke.
Night, ak^{n}a̱l—Z., P.; akab, M., K.
No, not, mi.—See *bad, light;* ma, M., K.; mu, Z. etc.
Nopal, pechtak—petok, Z.
Nose, ni^{i}—M., Tz., P., Ch., Z.
Nothing, minch'asai.
Oak tree, yaxté—yax txe, M., ceiba tree.
Old (of things), pōkŏ'—peka, Zq.
Onion, tuyal—u^{i}, M.
Opossum, ŭsoch—os, Tz., P.
Orphan, meba—meba, P., widow, widower.
Otter, tt'sich'a—ch'atsi, P., Z., Tz.
Owl, tuchkul—tunkul utxu', M., tukur, C.
Pain, ya—M.
Palm (of the hand), tan kk'ab—M.
Palm tree, pŏch.
Petticoats, ch'ūnăl.
Physician, ach'nanum.
Pine (ocote), tach—Ch., Z., P.
Pine, white, zakal tach'.

Plate, dish, sek—sets, Z.
Plum, pōm—Tz.
Polecat, pa^{i}—M.
Potato (camote), isak—Z., iz, M., C., K.
Prairie, savanna, ch'ob—ch'on, Zq.
Pregnant, kutxan txamel.—See *load, sick.*
Pretty, tsamal—sam, Z.
Priest, ch'^{u}atik.—See *father.*
Quail, poch'^{u}ik.
Rabbit, txitx—utxib, Tz, istxik, Mm.
Rain, ch'a^{a}.—See *water.*
Rat, txitam txo—ttxo, M., Tz.
Red, txak—M., P., Tz., Ch., Z., kak, C., H., K.
Reed (bejuco), ak—M., Ch., Z., P.
Rib, xach'—saya apat, Zq.
Ring, circle, maka'—Zq., Z.
River, ch'ag^{u}anyok—lit. "water that flows."
Rivulet, yokch'a—M.
Road, street, be—M., Z., K.
Roof, sbolom naits—lit. head, house.
Root, yetx té—yetal, Tz.—See *tree.*
Salt, att'sam—Ch., Z., C., K., Tz., P.
Sand, ch'ich'kab—ch'i, Ch., Tz., P., Z.
Scorpion, tsek—Tz., Z.
Sea, niguan ch'a—lit. great water.
Seed, inat—inach', H.
Sheep, alagal txech'—lit. "domestic deer;" alakk', M.,=domestic animal.
Shoe, xanab—M., Tz., Ch., P., etc.
Shoulders, patik—Ch., Z., M.
Sick, txamel—Z., Tz., P. Comp. *dead.*
Side, tt'set—M., tselat, Tz., Z., P.
Sinew, txutxu^{i}—Z., Zq.
Sister, ^{u}ats—K.
Skin, hide, tt'sum—C., K.
Sleepy, ^{u}ayel—Z., H.
Small, tt'xin—Mm.
Smoke, tab (?)
Smooth, bilīts—lilitts', M., H.

Snake, txan—tsan, Zq., Ch., Tz., P., Z.; kan, M., K., Mm.
Snake, rattlesnake, ach'autxan—lit. "king snake."
Snow, ter (?).
Soft, ch'ul.
Son, of a man, kunin (my son; agunin, thy son)—une, Zq.
Son, of a woman, al—M., Ch., Tz., P., C., K.
Sound, $^{u}a^{l}$txinel—Z., M.
Sour, pach'—M., Ch., P., poch', Z.
Spindle, petet—Zq., Ch., M.
Spittle, yalel ti—lit. water, mouth.
Spoon, letx—lek, M., a gourd used in taking food.
Spring, fountain, yech'lub ch'a'.
Squirrel, txu—txutx, Ch., Tz., Z., P., txŭki, Zq.
Star, kanal—Z.; kanai, "above," M.
Stepmother, mach'an nan—M., Ch.
Stepfather, machan tat—lit. "loaned father."
Stomach, spa.
Stone, ton—Tz., Z., tun, M., Ch., etc.
Stone, for grinding meal, txa—Zq., H.; ka, M., C., K.
Stone, for cooking on, yŏch'ket—Tz., Z., P.
Stone, for sharpening, nuk ch'ux—ch'ux, M., Z.
Stranger, tuk txā nāb.
Sun, the, kk'agu—kk'akk'ul, Z., Tz.
Sweat, teka^{u}.
Sweet, txi—Z., M., C., K., H.
Tail, ne—M., Z., Ch.
Tapir, tsemen—Z., tsimin, M., Ch., Tz., P.
Tear, a, yalel sat—lit. water, eye.
Teat (nipple), mix.
That, itukote'—chastuk, Z.
There, tikote.—See *that.*
They, those, yenalé.—See *he.*
Thick, koch'lel.
Thief, elkk'anum—elek, Z., C.
Thin, bikit—Tz., M.
Thirsty—takintin—Z.
This, itu.
Thorn, kk'i^{l}x—M., K., Ch., Tz., P., Z., H.
Thread (of cotton), txalal.

Throat, tsoch'os.
Tick (wood-tick), sip—Tz., Z., P.
Toad, gŏ—ŭo, M.
Tobacco, ma^{i}—Tz., C., K., H., Z.
To-day, uaxa'—nax, Tz., Z.
Toe, yal ok.—See *foot.*
Tomato, pix—K.
To-morrow, ch'etxel.
Tongue, ak—M., Mm., Ch., P., Z., etc.
Tooth, ke—Z., P., ko, M.
Tortilla, ^{u}ach'—M., Ch., Tz., Z.
Town, txonab
Tree, te—Ch., Tz., Z., H., P.
Trunk (of a tree), top te'—lit. arse, tree.
Tusk, tsĭch'ye'—tsie', P., K., C., M.
Ugly, milek sat—lit. "face bad."
Urine, txulal—C., K.
Wall, pakk'ab—pakk', M.
Warm, kk'ixin—Z.
Water, ch'a—M., Ch., Tz., P., K., E.
Wax, txabek—Tz.
We, tuk (?)
Well, ch'okom—ch'ok, Z., P., Tz.
West, the, ba^{a}ax muxik kk'agŭ.
What? ch'ax—bax, M., Tz.
When? ch'aimach'ke.
Where, ba^{a}—C., Tz., P., Z.
White, sak—M., Tz., Z., C., K., Po., Ch., P.
Who? matx—Tz., M., Ch., P.
Wide, nig^{u}an sat.—See *eye* and *great.*
Wife, xtxeum—x=fem. prefix.
Wind, ikk'—M., Ch., Tz., P., etc.
Wing, ^{u}etx—^{u}itx, Ch., P.
Woman, ixuk—C., K., Po., P., I., etc.
Woman, old, mem—mim, M.
Wood, té.—See *tree.*
Woods, kk'ul.
World, sat kinal.—See *eye;* kin, M.=sun.
Worm, yal txan—lit. son, snake.

Year, ch'abil—M., Ch., Z.
Yellow, kk'an—M., Tz., K., Po., kk'ŏn, P., Ch., kam, Mm.
Yesterday, eké—ŏkk'ŏbi', Ch., "och'ei, Tz., akbi, P.
You, "enale.
Young of an animal, yal—Z., M., alach, C. See *son.*
Youth, a, kerem—Z.
Yucca, tsinté—M., Z., Ch.

Numerals.

1. ch'uné	17. ch'uklach'uné
2. txabé	18. "axaklach'uné
3. oxé	19. balach'uné
4. txané	20. ch'untach'be
5. ch'oé	21. ch'unextxa "iniké
6. "aké	30. lach'unextxa "iniké
7. ch'uké	40. txa "iniké
8. "axaké	60. ox "iniké
9. baluné	80. txan "iniké
10. lach'uné	100. ch'o "iniké
11. buluké	120. "ak "iniké
12. lach'txané	160. "axak "iniké
13. oxlach'uné	200. lach' "iniké
14. txanlach'uné	400. ch'un xané
15. ch'olach'uné	800. txa xané
16. "aklach'uné	8000. ch'un ch'ikipil

Vocabulary of Sanchez.—The vocabulary of the *cura* of Ocosocantla is much less satisfactory than that of Dr. Berendt. Not only is the manuscript written in a hand far from readily legible, but evidently the writer had no personal knowledge of the tongue, and managed with difficulty its consonantal asperities. Nevertheless, it contains a number of words not in Dr. Berendt's, especially verbs and verbal phrases, and throws some light on the syntax. The alphabet employed is the Spanish, without any defined system for expressing sounds not in that tongue.

Vocabulary of Chane-abal, from MSS. of Rev. José Maria Sanchez (about 1860).

Afternoon, late, xhocheaqui.
Bride, yajmul.
Ceiba tree, aqueuc.
Cold, chee.
Cooked, coxhoxh.
Dog, tri.
Drum, pumpumquajat
Dry, taquinxha.
Enemy, mivojite (not-friend).
Frog, chuxh.
Half, a, snatan.
Hill, quitz.
Hog, chitam.
Kernel, seed, saquil.
Little, a, tuzan.
Married, a married man, napamel.
Monkey, machin.
Mountain, lutu.
Much, very, guajel.
Plain (level area), job.
Pretty, tramal.
Rat, choho.
Reed, cane, caem.
Ripe, taqan.
Rosary, quentexhal.
Scorpion, tree.
Soul, attrilla.
Tarantula, xhulatmut.
Thief, elum.
Track, footprint, yoqui.
Turpentine, cataq.
Unripe, yahan.
Uncooked, trehe.
Whistle, a, aymai.
Word, abal.

Verbs and Phrases.

To kill - milqi.
To hear - aquavi.
To know - capticon.
To pluck, to gather - yaj.
To ask - canalli.
To wrap - quaxhuay.
To break - tama.
To chew - loxha.
To sin - ae mul (thou sinnest?)
To carry - culan.
To burn - quaxhohayh.
Open! - jama.
Say! - ala.
Thou seest me not - mi xhaquel aquon.
Leave thy bride - ya cari yajmul.
Sit down - guaxhacuyi.
Before or in the presence of God - satagel Dios.
Make the sign (of the cross) - siqan haba.*
We went to the river with John - Soc ha Juani quaqiontini qua ja.

* Camposeca gives this phrase: *Alà viz à bà.* (*Confesionario, U. S.*)

Personal Pronouns.—In neither of the vocabularies before me is the scheme of the personal pronoun satisfactorily developed. As far as they go it is as follows:

	Sanchez.	*Berendt.*
FIRST PERSON.		
I	agunen	kena.
Of me	ua.	
For or with me	svaquena.	
We	quenticon	tuk.
Of us	sva hay.	
For or with us	sva quentiqhon.	
SECOND PERSON.		
Thou	jasta lavil	ʷena.
Of thee	uaquena.	
For or with thee	svaquena.	
You	svaquenalexh	ʷenales.
For or with you	svaqueualexh.	
THIRD PERSON.		
He, it	jastu	{ itukoté
Of him	svagmo	{ yena.
For or with him	svagmo.	
They	jahé	yenale.
Of them	svatué.	
For or with them	svagmotic.	

Besides allowance for the imperfect phonetics of Father Sanchez, there are other obvious misunderstandings in his expressions. The third person *jastu* is the Zotzil *ch'astuk*, "that one there;" and the second person singular is apparently this word combined with the possessive "that is thine." Dr. Berendt is also in error in giving *tuk* we, and *itukoté* he. The word *itu* means "this one," and *tikote*, "there." The correct form of the personals is:

I, *k-ena*.	We, *k-entikon*.
Thou, *ʷēna*.	You, *ʷ-enalek*.
He, *y-ena*.	They, *y-enalek*.

The termination *ena* is, I believe, the word for "body," as in Zotzil *gh'naa*, my body or flesh; *z'naa*, his body. In a similar manner it is used in the English indefinite pronouns "somebody, anybody," and in the French Creole of Hayti it has supplanted the reflexive *se*, as in the phrase

jidé corps-ou, épis lôte 'a jidé ou.
help body you, and then others aid you.

Help yourself and others will help you.*

We thus reduce the personals to the initial sounds—

k, *w*, *y*.

Comparing these with the scheme of the personal pronouns in the Quiche, Pokomchi, Maya, Zotzil, and Huasteca, presented by the Count de Charencey, we find no complete analogies with any one of these dialects, though more or less with all.† This indicates that the Chane-abal is a distinct dialect of the Mayan family, and not merely a sub-dialect of Cakchiquel or Zotzil.

Possessive pronouns.—The possessives have the same form in the singular and plural, number being indicated when necessary by the termination of the thing possessed. The forms of the pronouns, however, change with reference to the initial sound of the following word. This will be seen in the subjoined table:

FIRST PERSON.

ch'tat, my father, the form *ch'* being employed before all consonants except *s*, *n*, and *p;* with these *s* is required, as, *s-nok*, my clothes. *k-al*, my son (a woman speaking, as the word *al* refers to bearing the child).

ch'-tatik, our father, our fathers, or my fathers.

k-altik, our son, our sons, or my sons.

s-satik, our eye, our eyes, or my eyes.

SECOND PERSON.

a-tat, thy father; *a*^{u}al, thy son.

a-tatex, thy fathers, your father, or your fathers.

a-ualex, thy sons, your son, or your sons.

THIRD PERSON.

s-tat, his or her father; *y-al*, her son.

s-tatik, his or her fathers, their father, or their fathers.

y-altik, her sons, their sons.

Texts.—The only published texts in this language are the *Confesionario* of Camposeca, already mentioned, and a version of the Lord's Prayer, printed by Pimentel in the first and third volumes of his work on the languages of Mexico. Pimentel states that he obtained his copy from Señor Orozco y Berra, who, in turn, had it from "a reliable source" (*de buen origen*).‡ It is as follows:

* See Van Name, *Contributions to Creole Grammar*, p. 139, in *Transactions of the American Philological Association*, 1869-'70.

† Charencey, *Le Pronom Personnel dans les Idiomes de la Famille Tapachulane-Huasteque*, in the *Mémoires de l'Académie Impériale de Caen*, 1868.

‡ *Cuadro Descriptivo y Comparativo de las Lenguas Indígenas de México.* Tom. I, p. 231, Tom. III, p. 280.

Tattic hayá culchahan tanlinubal á vihil jacué eg bagtic á guajan acotuc á guabal hichuc ili luhum jastal culchahan.

Yipil caltzil eg güiniquil tic aquitic sva yabanhi soc culanperdon eg multic hichuc qucj ganticon guazt culanticon perdon machá hay smul sigilticon sec mi ztagua concotic mulil mas lec coltayotic scab pucuj jachuc.

Pimentel does not attempt to analyze this text, and Dr. Berendt has a note upon it to the effect that it is in many points erroneous and that persons in Comitan well acquainted with Chane-abal, to whom he read it, did not recognize a number of the words. Perhaps it is in a dialect other than that of Comitan. At any rate most of the words are easily recognizable.

Tattic, for *ch'tatik*, our father.
hayá, a demonstrative frequently used by Camposeca.
culchahan, for *kultxan*, heaven.
tanlinubal, verbal noun, "something to be guarded." Tzendal, *tanih*, to take care of, to guard.
á, possessive pronoun, second person singular.
vihil, for *bil*, name.
jacué, sign of the optative.
eg bactic, to come, like Tzendal *tzulezba*.†
á guajan and *á guabal*, both from *ahau*, of Berendt's vocabulary, meaning thy rule, sovereignty. The possessive, *á*, thy, has taken the place of the first vowel; it should read *á aguabal*.
hichuc, even as; see *Vocab.*
ili, here
luhum, earth, on earth.
jastal, in that manner.

This analysis need not be extended. It is enough to show that the text is a genuine one, though either dialectic or imperfect.

I shall also insert a sentence from the *Confesionario* of Camposeca, as published by the Count de Charencey, in order to illustrate the method employed by that native in reducing his tongue to writing:

Hay ama eyui cacà puro yacbil xsha huàg petzanil à taquin sbovi xsagua viquè à cheun? Ò lom ma tat esquina, ma tat paxsial?

"Hast thou past the days in drunkenness, drinking away all the money which thou oughtest to give to thy wife? Or in idleness, on the corners, or in walking?†

**Vocabulario en lengua Tzeldal* (sic) *de Copanabastla, 1620.* MS. in my possession.

† *Revue de linguistique*, Tome XX, p. 238 (Paris, 1887).

Affinities numerically estimated.—It is an odd characteristic, which must be markedly prominent in the language, which gave it the name "the four languages," or "the fourfold tongue." We may expect to find in it, in a double degree, the traits which Iriarte, in his *Fabulas*, attributes to the speech of one of his characters:

"Mezclando dos hablas, la nueva y la vieja."

To ascertain the precise percentage of other dialects present in the Chane-abal, Dr. Berendt submitted his vocabulary of 416 words, excluding numerals and pronouns, to a close comparison, and drew up the following table:

Comparison of the Chane-abal with other dialects of the Maya Family.

Of 461 Chane-abal words there are—

Identical with the Zotzil	185
with the Maya	147
with the Tzendal	121
with the Cholti	118
with the Chontal	106
with the Cakchiquel	85
with the Kiche	84
with the Huasteca	30
with the Mame	17
with the Pocomame	14
with the Ixil	6
with the Chorti	4

Undoubtedly these affinities would have been more numerous but for the deficient vocabularies we have of several of these dialects. Enough remain, however, fully to vindicate the correctness of Ximenez in classing the Chane-abal among the Maya dialects. Furthermore, noting the large percentage of words from Guatemalan dialects, we may safely assume that the line of migration of this tribe was from Guatemala to its present abode.

The Zoque (*Trokek* of Pineda) is not a Maya dialect, and it is not strongly represented in the vocabulary. Of the whole 461 words only 30 show Zoque affinities, and many of these are common to the adjacent dialects of the Maya stock. It is noticeable that most of them refer to manufactured objects or to the materials from which such objects were made in primitive times. Thus the words for seat, bed, bench, spindle, jar, mealing-stone, nest, bone, sinew (a string), and foam (in boiling), are approximately the same. This seems to indicate that the influence of these diverse stocks upon one another arose after a certain degree of culture had been obtained by one in excess of the other, and that with the introduction of this culture its terms were also adopted.